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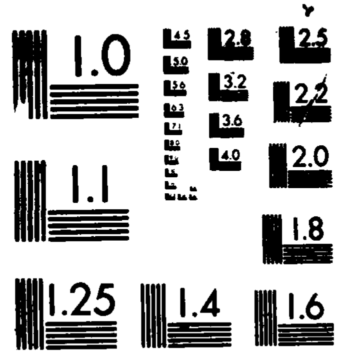

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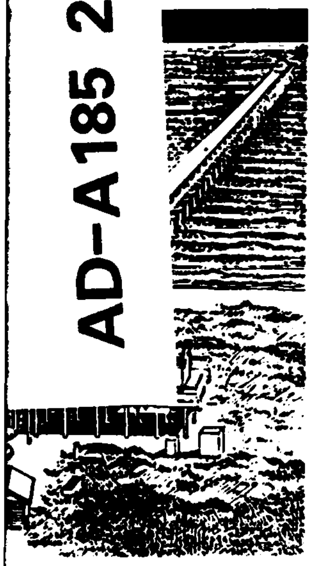

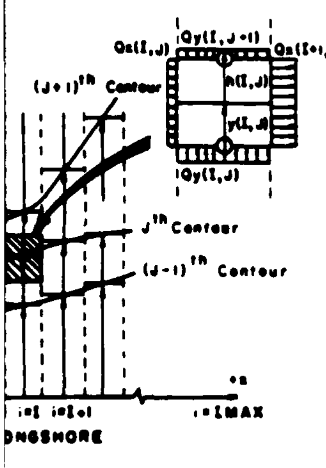

INSTRUCTION REPORT CERC-87-4

12

A USER'S GUIDE TO THE N-LINE MODEL: A NUMERICAL MODEL TO SIMULATE SEDIMENT TRANSPORT IN THE VICINITY OF COASTAL STRUCTURES

by

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A user's manual was developed for the N-line numerical sediment transport model by the Coastal Engineering Research Center (CERC). This report provides the necessary guidance, complete with multiple example applications which include model input and output, for using the N-line numerical model. Capabilities of the model include the simulation of (a) single or multiple shore-perpendicular structures, (b) single or multiple detached offshore breakwaters, and (c) disposal of material or dredging of material in the coastal zone. Model parameters are discussed in order to guide the potential user to a successful application of the model.

The N-line model is versatile, easy to use, and capable of producing dependable results when used for appropriate applications. The documentation presented in this manual is intended to cover only the breakwater subroutine. Since conceptual modifications were

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not made to the original model, the original documentation, presented in CERC's report MR 83-10, should be obtained by any potential user of the model.

The N-line model is useful in showing qualitative trends for a complex case such as Lakeview Park, Lorain, Ohio. Some of the drawbacks of the program when modeling Lakeview Park, such as the inability to reach an equilibrium shoreline, and the low sinuosity of the shoreline when influenced by breakwater segments, could possibly be successfully modeled by modifying the different input parameters, such as the ADEAN parameter and/or initial shoreline location and/or the model code. Perhaps then a quantitative verification of the model could be made. However, in this case, the model would have then been tailored to produce a previously known result.

A project cannot be successfully modeled without experimenting with different time-steps, space-steps, contour depths, shoreline locations, and structure configurations. A wave climate representative of the area being modeled is also very important. Finally, the response of the model to a particular setup must be interpreted with engineering judgment.

PREFACE

This study was authorized as a part of the Civil Works Research and Development Program by the Office, Chief of Engineers (OCE), US Army. The work was jointly performed under Work Unit C31551, Numerical Modeling of Shoreline Response to Coastal Structures, which is part of the Shore Protection and Restoration Program and Work Unit C31232, Evaluation of Navigation and Shore Protection Structures, which is part of the Coastal Structure, Evaluation, and Design Program. Messers. J. H. Lockhart, Jr., and J. Housley were OCE Technical Monitors.

This guide was developed to make the N-line model, developed for the Coastal Engineering Research Center (CERC) by Mr. Marc Perlin and Dr. Robert G. Dean, of the Coastal and Offshore Engineering and Research, Inc., Newark, Delaware, available in an easy-to-use-and-apply format. This has been accomplished by providing detailed examples demonstrating appropriate model applications. Each example includes a listing of the model input parameters and a complete output file for user comparison. The model includes an interactive input data generator for fast and easy application of the model. Program listings are provided in the appendix of this report. Magnetic tape copies of the code can be obtained by contacting the Engineering Computer Programs Library Section of the Technical Information Division, US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi.

This guide was prepared by Dr. Norman W. Scheffner of the Research Division, CERC, and Ms. Julie Dean Rosati of the Engineering Development Division, CERC. The report was prepared under the direction of Dr. James R. Houston, Chief, CERC, and Mr. Charles C. Calhoun, Jr., Assistant Chief, CERC.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

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CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
cubic yards	0.7645549	cubic metres
degrees (angle)	0.01745329	radians
feet	0.3048	metres
inches	2.54	centimetres

A USER'S GUIDE TO THE N-LINE MODEL: A NUMERICAL MODEL TO SIMULATE SEDIMENT TRANSPORT IN THE VICINITY OF COASTAL STRUCTURES

PART I: INTRODUCTION

1. The US Army Engineer Waterways Experiment Station, Coastal Engineering Research Center (CERC), presently supports a general use numerical model for simulating sediment transport and bathymetric changes in the coastal zone. The original report, "A Numerical Model to Simulate Sediment Transport in the Vicinity of Coastal Structures" (Perlin and Dean 1983), detailed an N-line model developed to simulate the effects of single or multiple, equal length groins and/or offshore dredged material disposal on the shoreline location and the local bathymetry. These changes are the result of wave action from an offshore wave field of known period, height, and direction. Subsequent enhancements to the model include the effects of single or multiple detached breakwaters; the capability of handling multiple unequal length groins; the capability to specify an initial nonstraight shoreline; and the addition of a separate, user-friendly program to generate input data files for the N-line model.

2. The purpose of this report is to provide a user's guide for applying the model to specific cases of interest. Theory of the model, with the exception of the breakwater subroutine, is not covered in this report. Those details can be found in the program documentation (Perlin and Dean 1983). This report includes (a) a description of the capabilities and limitations of the model, (b) a brief documentation of the breakwater subroutine, and (c) details on how to apply the model to specific cases. Since the intent of this report is to provide a potential user with enough guidance to properly use the model, specific input and output listings for detailed applications of the model. This approach will allow the user to become familiar with generating data and running the model are given. The sample output is provided as a check to verify that the model is producing the correct results for a given input condition. This solution also is valuable for comparison when the model is run on different computer systems. Finally, a listing of the model and the data file generation program is provided. Appendix A provides example input and output, while Appendix B provides the program listing.

PART II: CAPABILITIES AND LIMITATIONS

3. The intent of the N-line model is to provide the user with a tool to adequately predict the effects of modifications to the coastal zone if certain criteria are met. For example, the model was developed for specific application to coastal areas that are predominately influenced by waves and that are not characterized by complex bathymetries such as offshore bars, barrier islands, or deep and/or irregular channels. Areas of this complexity require more sophisticated, expensive, and difficult-to-apply numerical models. Physical models may even be required in some cases. The N-line model may, however, provide adequate results even to relatively complex areas if the user is aware of the limitations of the model and interprets the results with these limitations in mind. Incorrectly used, this model, as with any model, can yield erroneous results that must be recognized as resulting from poor input data or from an application to a situation beyond the capabilities of the model. It is the modeler's responsibility to correctly use and interpret the results of the model.

4. The limitations of the N-line model that restrict its applicability are a result of the basic formulation of the model. Certain physical processes are not accounted for in the governing equations. For example, the model simulates refraction and diffraction, onshore/offshore and alongshore sediment transport, and conservation of mass resulting from a known wave field. The model does not simulate tidally induced velocities and water levels nor does it simulate wave-induced currents and setup/setdown. The assumption that these complex effects are minor in comparison to the wave field allows for a simplified set of governing equations that result in a model which can easily and economically be used as a design tool. Cases in which tidal and/or wave-induced effects are significant require the use of additional governing equations resulting in a highly complex numerical model which is both difficult and expensive to apply. The purpose of the N-line model is to provide the user with a tool for the prediction of changes in the primarily wave-dominated coastal zone.

5. The distinction between an appropriate and inappropriate application of the model is difficult to define since certain idealizations and simplifications can be made that might adequately represent the physical system. This will often result in qualitative results that are useful in determining trends

or rates of change. In order to make a decision as to whether or not the model can be applied to a given situation, the following list of major assumptions and limitations of the model must be consulted:

a. The model is based on an equilibrium beach-profile concept. This requires that the beach profile be assumed to monotonically increase in depth in the offshore direction. The relationship used in the model is

$$h = Ay^{2/3}$$

where

h = depth
A = Dean's equilibrium profile coefficient
y = distance offshore

The entire modeled area is assumed to have this profile.

b. The offshore boundary condition for the model is the specification of a single wave climate for the entire offshore boundary. Although this can be changed at each time-step, it must apply to the entire length of coastline being modeled.

c. Shore-connected structures, such as groins or jetties, must be perpendicular to the specified baseline. This requirement is a consequence of the computational grid employed by the model.

d. The model is based on mean sea level and has no provisions for deviations from a mean condition.

e. The addition of offshore dredged material disposal is made by advancing the appropriate depth contours offshore by an amount equivalent to the quantity of material added. Because of the limitations imposed by the monotonically increasing depth assumption, a berm or dredged material island cannot be modeled.

f. Limitations of the modeling of a breakwater will be covered in the next section.

6. Several of the above limitations could be modified. For example, a separate equilibrium profile could be specified for each location along the modeled area. This could be in the form of a spatially variable coefficient A, which could be determined from a series of shore-perpendicular profiles. Similarly, mean sea level changes could be incorporated in the model formulation. Assumptions such as the equilibrium profile concept with a monotonically increasing depth are, however, basic assumptions of the model and cannot be altered. If a particular application cannot be adequately represented with these assumptions, the N-line model should not be used.

PART III: DETACHED OFFSHORE BREAKWATERS

7. A subroutine was added to the original N-line model described in Perlin and Dean (1983) to extend the applicability of the model to include the effects of detached offshore breakwaters. This subroutine was developed to utilize the computational procedure of the existing model. Certain assumptions and simplifications were made in order to achieve compatibility with the basic model. The major simplification is that only the refractive, diffractive, and transmissive effects of the breakwater on the wave field are considered. The physical existence of the breakwater (e.g., a small island) was not possible due to the N-line model formulation of a monotonically increasing depth offshore. The consequences of this assumption will be discussed in paragraph 12.

8. The procedure used for the breakwater computations was to first calculate the entire wave-field distribution using the N-line model as if no breakwater existed. The effects of the breakwater on the wave field can then be determined by adding the diffracted and refracted wave energy vectors from each breakwater tip to the previously computed vector components at each grid point. If the grid point falls in the shadow zone of the breakwater, the N-line-computed contribution is multiplied by a user-supplied transmission coefficient.

9. A more comprehensive description of the computational procedure can be made by referring to Figure 1 and to the list of variables shown in Table 1. The sequence of events is as follows:

- a. Calculate the breakwater orientation angle (BRKANG).
- b. Calculate the depth (DEEPL, DEEPR), angle (THETAL, THETAR), wave height (HLFT, HRT), celerity (CLFT, CRT), and group velocity (CGLFT, CGRT) for the left and right tips of the breakwater based on a linear interpolation of N-line-computed values.
- c. Calculate the left and right X-coordinate for the shadow zone (XXL, XXR).
- d. Calculate the local contour line orientation (CONANG) and the X- and Y-components of the N-line-computed wave height based on the N-line-computed wave angle (THETA).
- e. Calculate the angle from the tip of the breakwater to the grid point (ANG). A separate computation is made for diffraction from the right and left tips of the breakwater.
- f. Calculate wave height at the local point using the diffraction subroutines included in the N-line model (HTEMPR, HTEMPL).

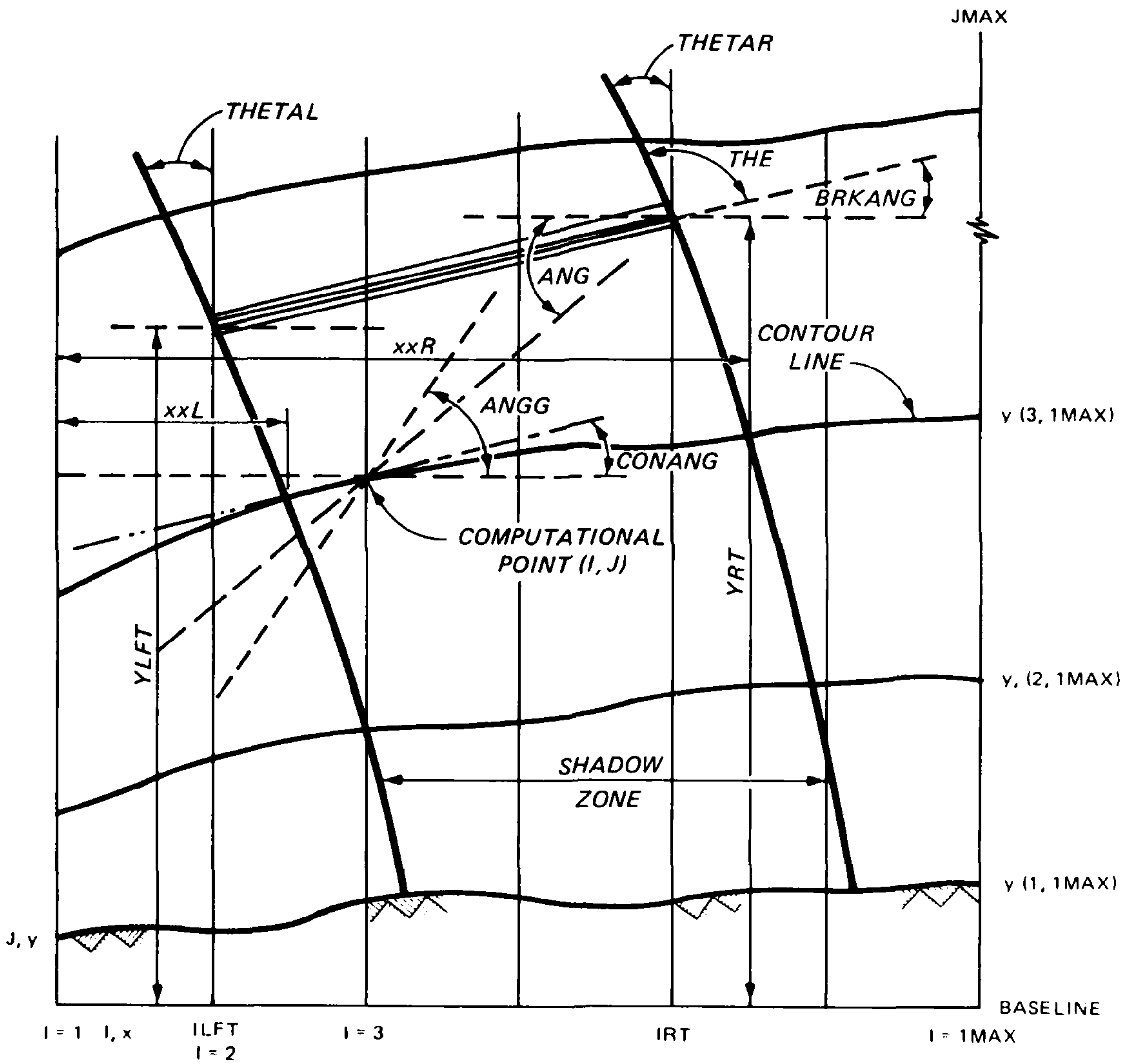

Figure 1. Schematic diagram of breakwater

Table 1

List of Variables

Parameter Name	Used For
ILFT(N)	I-location of left end of breakwater
IRT(N)	I-location of right end of breakwater
YLFT(N)	Distance offshore to left end of breakwater
YRT(N)	Distance offshore to right end of breakwater
NOBKS	Total number of breakwaters
DEEPR(N)	Depth at right end of breakwater
DEEPL(N)	Depth at left end of breakwater
HRT(N)	Wave height at right end of breakwater
HLFT(N)	Wave height at left end of breakwater
THETAL(N)	Wave angle at left end of breakwater
THETLL(N)	Wave angle used at left edge of shadow zone
THETAR(N)	Wave angle at right end of breakwater
THETRR(N)	Wave angle used at right edge of shadow zone
XXL(N)	X-location of left edge of shadow zone
XXR(N)	X-location of right edge of shadow zone
CLFT(N)	Wave celerity at left end of breakwater
CRT(N)	Wave celerity at right end of breakwater
HTEMPR(N)	Wave height contribution of diffraction from right end of breakwater
HTEMPL(N)	Wave height contribution of diffraction from left end of breakwater
HTXL(N)	X-component of HTEMPL
HTYL(N)	Y-component of HTEMPL
HTXR(N)	X-component of HTEMPR
HTYR(N)	Y-component of HTEMPR
YLLFT(N)	Y-location used to calculate left edge of shadow zone
YRRT(N)	Y-location used to calculate right edge of shadow zone
DXL(N)	X-distance used in calculation of left edge of shadow zone
DXR(N)	X-distance used in calculation of right edge of shadow zone
BRKANG(N)	Angle of the breakwater with respect to baseline
CGRT(N)	Group velocity at right end of breakwater
CGLFT(N)	Group velocity at left end of breakwater
XXDIST	X-distance to point (I,J)
HX	X-component of H (I,J)
HY	Y-component of H (I,J)
THETA(I,J)	Wave angle at I-,J-location
Y	Y-distance to I-,J-location
ANG	Diffraction angle from breakwater tip
ANGJET	Angle from breakwater tip to jetty tip
ANGG	Refracted value of ANG at point I,J
THE	Wave angle at breakwater adjusted for BRKANG(N)
AMP	Amplitude factor after diffraction
SHADOW	Zone in lee of breakwater
H(I,J)	Wave height at I-,J-location
HB(I,J)	Breaking wave height at I-,J-location
CONANG	Angle of local contour at I-,J-location

g. Calculate the refracted angle for the wave at the local point by using Snell's Law. For this computation, a shallow-water wave approximation is used for wave celerity. The computed angle is then adjusted to compensate for the local contour angle.

h. Compute the X- and Y-components of the diffracted wave from each tip by using the refracted wave angle (HTXR, HTYR, HTXL, HTYL).

i. Multiply the X- and Y-components of the N-line-computed wave heights by a shadow-zone factor. This coefficient is equal to unity when the point is not in the shadow zone behind the breakwater.

j. Sum all the contributing waves for each grid point, based on conservation of energy, and calculate an effective wave height and angle (H,THETA). For example:

$$XXX = \sum_{i=1}^{NOBKS} \left(HTXL_i {*} \, |HTXL_i| + HTXR_i {*} \, |HXTR_i| + HX {*} \, |HX| \right)$$

$$YYY = \sum_{i=1}^{NOBKS} \left(HTYL_i {*} \, |HTYL_i| + HTYR_i {*} \, |HTYR_i| + HY {*} \, |HY| \right)$$

$$H = \sqrt{|XXX| + |YYY|}$$

$$THETA = ATAN \left[\left(XXX / \sqrt{|XXX|} \right) \Big/ \left(YYY / \sqrt{|YYY|} \right) \right]$$

where NOBKS = the number of breakwaters in the modeled area.

10. The above formulation includes some simplifications that were not felt to be significant. These were considered to be justifiable since a rigorous treatment of the process of refraction and diffraction from a detached breakwater would require a total reformulation of the N-line model. In view of the original purpose of the model, reformulation was not considered appropriate.

11. The breakwater subroutine does not include a second diffraction and refraction of the breakwater-diffracted wave around groins or jetties. The program will compute a shadow zone behind each groin or jetty and will set the breakwater-diffracted wave components to zero for that area. Since it is unlikely that shore-perpendicular structures would be located directly behind a detached breakwater, this simplification appears adequate.

12. The unavoidable simplification of not recognizing the physical

presence of the breakwater in the surf zone was mentioned in paragraph 7. This approach introduces two physical processes which must be considered in the numerical model formulation. First, an actual breakwater causes the incoming waves to break, due in part to the decrease in depth in the vicinity of the structure. The exact location of the breaking point is primarily a function of both wave height and water depth. The model formulation assumes the breakwater can be considered as an abrupt barrier so that the wave height at the breakwater is equal to the wave height at the location computed by the N-line model. This value is used to diffract the wave around the breakwater tip. The breaking wave height and depth used in the N-line model for onshore/offshore sediment transport calculations are replaced by the height and depth at the breakwater location unless the wave would have broken seaward of the breakwater. Values between breakwater tips are calculated by linear interpolation of heights and depths at the ends of the breakwater.

13. The second process associated with a real breakwater is that depth contours do not cross the breakwater but tend to show a depth decrease shoreward of the breakwater and a depth increase offshore. This phenomenon cannot be correctly simulated by the N-line model without making alterations to the basic formulation. The solution adopted was to retain the N-line computations as if no breakwater existed. This will allow the contours to cross the breakwater; however, due to the decrease in wave energy inside the breakwater, the tendency is for the contours to behave in a qualitatively correct manner. This can be seen in the contour plots shown in Part IV.

14. The simplifications employed in the formulation and solution approach of the breakwater subroutine were made in order to achieve total compatibility with the existing N-line model. Consequently, very few changes have been made to the original model. Any questions concerning basic assumptions or numerical methods are referred to the program documentation (Perlin and Dean 1983).

PART IV: APPLICATION OF THE MODEL

15. The primary advantage of the N-line model over more complex numerical models is that, if applicable to the situation, the N-line model can be easily and economically used to simulate the physical problem and to provide a great deal of information on two-dimensional (2-D) changes in the modeled area. This simulation includes the capability to make predictions on the order of several months to several years. Simulations of this order of magnitude are not economically feasible with more complex sediment-transport models.

16. Application of the model to a specific or hypothetical situation is relatively easy. For example, there is no requirement for generating a complex computational grid, boundary conditions other than the offshore wave climate do not need to be specified, and a minimum of input data is required. The following list contains variables that are required. These can be classified as the basic model parameters that define the modeled area, and the time-dependent parameters that must be introduced at each time-step. A more complete description of a majority of the input variables can be found in Perlin and Dean (1983). Required variables include:

a. Basic parameters (see Figure 2 and Table 2):

(1) IMAX--The total number of alongshore grid cells used to adequately represent the modeled area. The examples in Perlin and Dean (1983) and in this report used 50. The specification of a total number much exceeding this will significantly increase the cost of running the model; therefore, some care should be exercised in selecting this number.

(2) JMAX--The total number of computational contour lines (Y-direction grid cells) used in the modeled area. Numbers in the vicinity of 8-10 were used in the examples. This number will have to adequately define the bathymetry in the modeled area by defining enough contour lines between the shoreline and the offshore depth defined by the variable WDEPTH. The parameter statements in the code (see Appendix B) must reflect NI = IMAX + 3 and NJ = JMAX + 3 for correct dimensioning.

(3) WDEPTH--The depth of water, defined in metres (as in the original publication), corresponding to the location of the input wave conditions. This depth represents the offshore boundary depth contour and is used as a constant computational boundary condition. A value of 10 m was used in all examples.

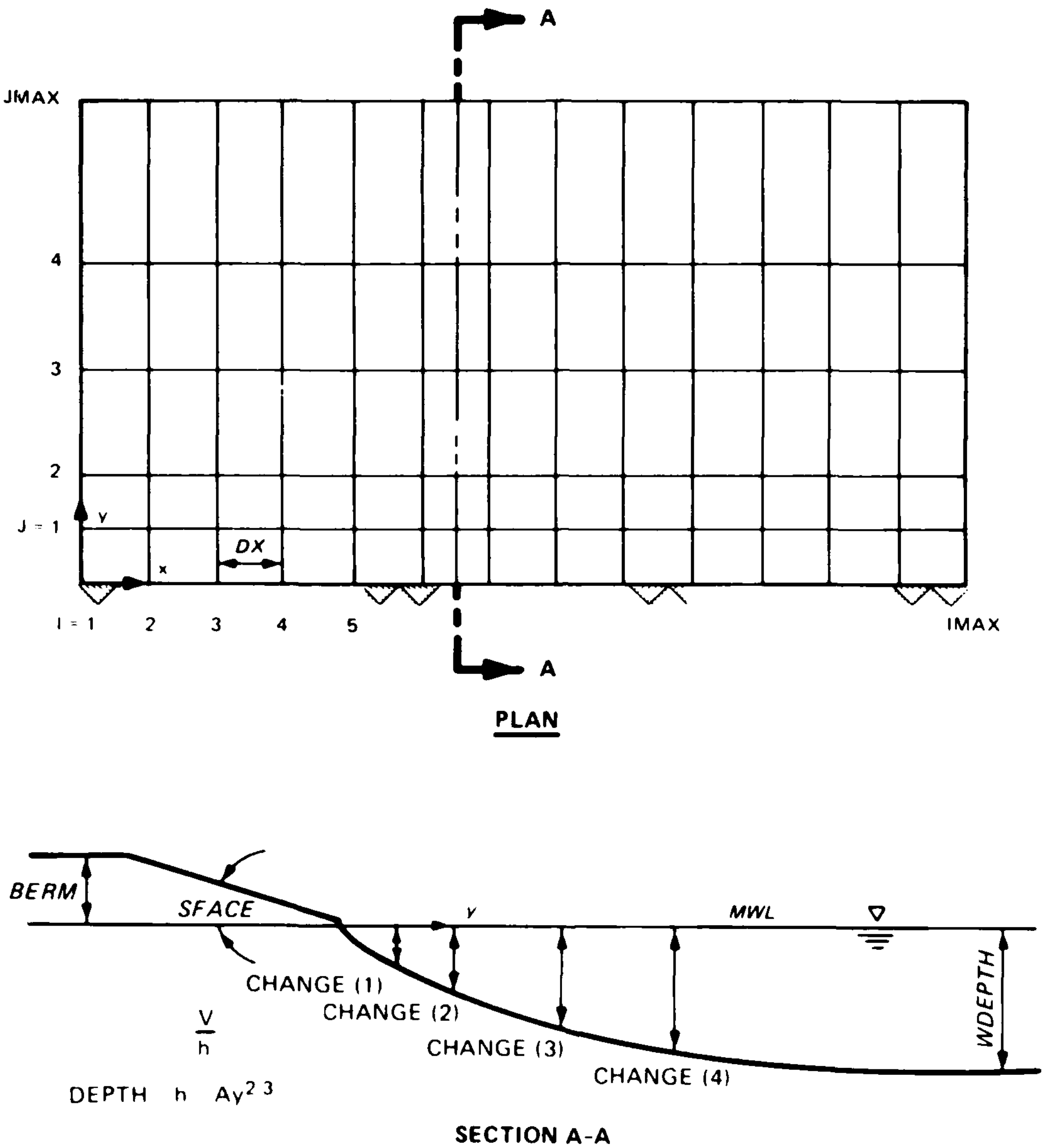

Figure 2. Schematic diagram of modeled area
(mwl = mean water level)

Table 2
Input Parameters

Card	Variables	Format	Comment
1	IMAX, JMAX	2I10	
2	WDEPTH	10X,F10.3	In metres
3	CHANGE(N), N = 1, JMAX + 1	10F8.3	
4	NWRITE	I10	
5	BERM, SFACE, DIAM	10X,F10.3,F10.4, F14.3	
6	MMAX	I3	If none exist, enter 1 and see next card
7	IJET, SJETTY	I3,F10.3	One card per structure. If none exist, enter any location and zero length
8	ADEAN	F10.4	
9	DX, DELT	2F10.3	
10	Y(I,1), I = 1, IMAX	10F8.2	
11	NOBKS	I5	If none, enter zero
12	ILFT, IRT, YLFT, YRT	10X,2I10,2F10.2	One card per structure. If none exist, omit card
13	HS, T, ALPWIS, IDDD	I5,5X,3F6.1, I5	This card is repeated for the desired number of time-steps in the total simulation. The simulation is terminated when HS > 50. If dredged material is to be added to any time increment (IDDD = 1), the IDREG, JDREG, and DREDGE cards must be inserted
14	IDREG, JDREG, DREDGE	2I5,F10.2	The dredged material simulation is terminated when IDREG = JMAX

(4) CHANGE--A one-dimensional array that specifies the numerical value of each contour line. For example: CHANGE(1) = 1.0, CHANGE(2) = 2.0, CHANGE(3) = 3.0, ...sets the J = 1,2,3,4, JMAX... + 1 contour lines to be the 1-ft,* 2-ft, 3-ft,... contour intervals. Note that JMAX + 1 values must be specified between a depth of 0 ft (shoreline) and WDEPTH (offshore boundary). The JMAX + 1 contour is merely a boundary condition used in conjunction with WDEPTH to define boundary derivatives. The 1 - JMAX contour lines represent the computational lines which will define the bathymetry of the modeled area.

(5) NWRITE--The desired frequency of printed output. The model provides a complete solution at each time-step. For a 1-month run at a 6-hr interval, 120 time-steps are computed. If, for example, only the weekly values are desired, enter NWRITE = 30 to print only every 30th output (i.e., 30, 60, 90, 120).

(6) BERM--A specified height of the berm (see Figure 2).

(7) SFACE--The slope of the beach face from the berm to the mwl (see Figure 2).

(8) DIAM--The mean diameter of the sediment particles in millimetres.

(9) ADEAN--The value of Dean's equilibrium constant. This value determines the distance offshore to a specified depth contour, $y = (h/A)^{1.5}$ ft; therefore, the values of CHANGE and A must produce the proper degree of resolution in the area of interest if reasonable results are to be expected. For a given A value, an improper selection of desired contour intervals (CHANGE) may result in contours located offshore of the area of interest. For example, a 3-ft contour with an A value of 0.15 will be 89 ft offshore. This contour will not provide much information about shoreline response to a groin that only extends 50 ft offshore.

(10) DX--The X-direction grid spacing in feet (see Figure 2). Exampls used for this report have varied from 50 to 100 ft.

(11) DELT--The time-step in hours. The examples used specify a value of 6 hr.

(12) Y(I,1)--Represents the initial shoreline location with respect to some reference line. A straight shoreline would be represented by Y(I,1) = 0.0 for IMAX values of I.

(13) MMAX--The number of shore-perpendicular structures (two groins, three groins, etc.).

(14) IJET--The I-grid location associated with each of the MMAX shore-perpendicular structures. The computations will consider the structure to be located to the right (increasing I) of the specified I-location.

---

* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 3.

(15) SJETTY--The length of each shore-perpendicular structure measured from the baseline.

(16) NOBKS--The number of detached breakwaters.

(17) ILFT,IRT--The I-grid location to be associated with the left and right end of each detached breakwater. Computationally, the I-value is assumed to be the exact location.

(18) YLFT,YRT--The exact Y-distance, measured from the baseline, offshore to the left and right tips of each detached breakwater.

b. Time-dependent parameters:

(1) HS--Offshore significant wave height (feet) specified at each time-step.

(2) T--Period of each wave in seconds.

(3) ALPWIS--The angle (-90 to +90 deg) of propagation of each wave wi .n respect to the x-axis. Waves propagating onshore from the left of shore-perpendicular are positive (see Figure 2).

(4) IDREG,JDREG--The addition of dredged material, beach fill, or any other alteration to the existing bathymetry is simulated in the model by advancing a contour by an amount which yields the appropriate volume of material. The IDREG and JDREG parameters indicate the location of the contour line that will be moved.

(5) DREDGE--Indicates the amount of movement, in feet, the contours are to be moved to simulate dredging, fill, etc.

(6) IDDD--A dummy variable used to indicate whether or not the dredged material/fill option is used. This is specified at each time increment. When IDDD equals 1, the amount specified by DREDGE is read resulting in a movement of the (I,J) contour by the amount specified. The option is not exercised when 0 is entered.

17. The program can be submitted to the computer by either using cards (batch) or interactively using a remote terminal. If cards are used, the user will have to supply an input card deck. The required and optional cards are shown in Table 2.

18. An alternative to using a card deck is to use the interactive capability of a computer. To simplify the input data requirements, a user-friendly interactive program has been written to generate input data files for the N-line model. Since CERC is presently using CYBERNET services for computer support, the model and input generator are currently operational on the CYBER 176 computer. A detailed description of the steps necessary to generate an input file and execute the model will be presented for terminal entry batch processing for the CYBER 176. A similar procedure is available for any computer system with interactive capabilities.

19. The interactive generation of data and subsequent execution of the N-line model require the following user files:

BLDFIL	Input data file generation program
INPFIL	Input data generated by BLDFIL (excluding dredged material)
SPOOL	Dredged material data (generated by BLDFIL)
RUNLINE	Job control file to submit the N-line model for terminal entry batch processing
TRANSP	The N-line model

Examples will be presented which demonstrate how to create input files for the model using the program BLDFIL. Following the creation of appropriate input files, the N-line model can be submitted and executed in a variety of ways. The following examples use the program RUNLINE to submit the job for terminal entry batch processing:

```
GET,RUNLINE
SUBMIT,RUNLINE,T
```

where the job control file RUNLINE contains the following control entries:

```
/JOB
JOB,T1500,CM200000,P4.
/USER
/CHARGE
GET,TAPE1=INPFIL.
GET,TAPE20=SPOOL.
GET,TRANSP.
FTN5,I=TRANSP,L=OUTPUT,REW=I/L.
BEGIN,IMSL5,IMSLCCL.
$LIBRARY,IMSL5.
LGO.
/EOR
```

Following execution, the job output can be either routed to a remote job entry facility or retrieved at the user's terminal.

20. Before presenting example model applications, an explanation of the model output must be made so that model results can be properly interpreted. This can best be accomplished by reproducing the computational representation of Figure 2 of Perlin and Dean (1985), shown here as Figure 3. As in many numerical models, certain computations are made for midpoints between the I,J modes. For example, Figure 3 shows that the sediment transport values in the

onshore-offshore direction Q_y correspond to the contours specified by the user (CHANGE(1), CHANGE(2), etc.); however, the alongshore values Q_x correspond to a point halfway between the I grid points. Numerical differentiation of the continuity equation then yields a y value corresponding to an I grid location, but a midcontour location:

$$\frac{\partial y}{\partial t} + \frac{\partial Q_x}{\partial x} + \frac{\partial Q_y}{\partial y} = 0$$

For example, if a CHANGE(1) and CHANGE(2) contour was specified as 1.0 and 2.0, the Y(I,2)-distance would correspond to the 1.5-ft depth. In all cases, the Y(I,1)-location corresponds to a zero depth. The understanding of the computational representation of these variables is absolutely necessary if the user intends to compute or tabulate total transport quantities in, for example, cubic yards per year.

21. The results of any numerical model, especially one based on empirical relationships, must be carefully examined to determine whether or not the results are realistic. Empirically based models are generally site specific, requiring the adjustment of various parameters and coefficients to achieve model results that match prototype behavior. The selection of these values can have a substantial effect on the model results. Improper selection can lead to erroneous results or even to numerical instabilities resulting in the model "blowing up." The following list represents some of those parameters and coefficients that can be varied to achieve stability or to obtain better agreement between model and prototype:

- a. DELT--The time increment used in the model has a substantial effect on the stability of the model. All example simulations shown in this report used a value of 6 hr.
- b. DX--The alongshore grid also has a marked effect on the stability of the model. The selection of a reasonable value must be made based on the structures present, the length of coast being modeled, and the stability of the model. For example, a detached breakwater should be at least three grid spacings. The spacings used in the examples varied from 80 to 100 ft.
- c. ADEAN--Dean's equilibrium profile coefficient determines the equilibrium profile for the entire modeled area. This coefficient should be determined by selecting a value that produces a beach profile which most closely matches the specific site being modeled. If no data are available to make this selection, the graph of ADEAN (signified by A in this figure) versus sediment diameter shown in Figure 4 (reproduced from Perlin and Dean 1983) can be used.

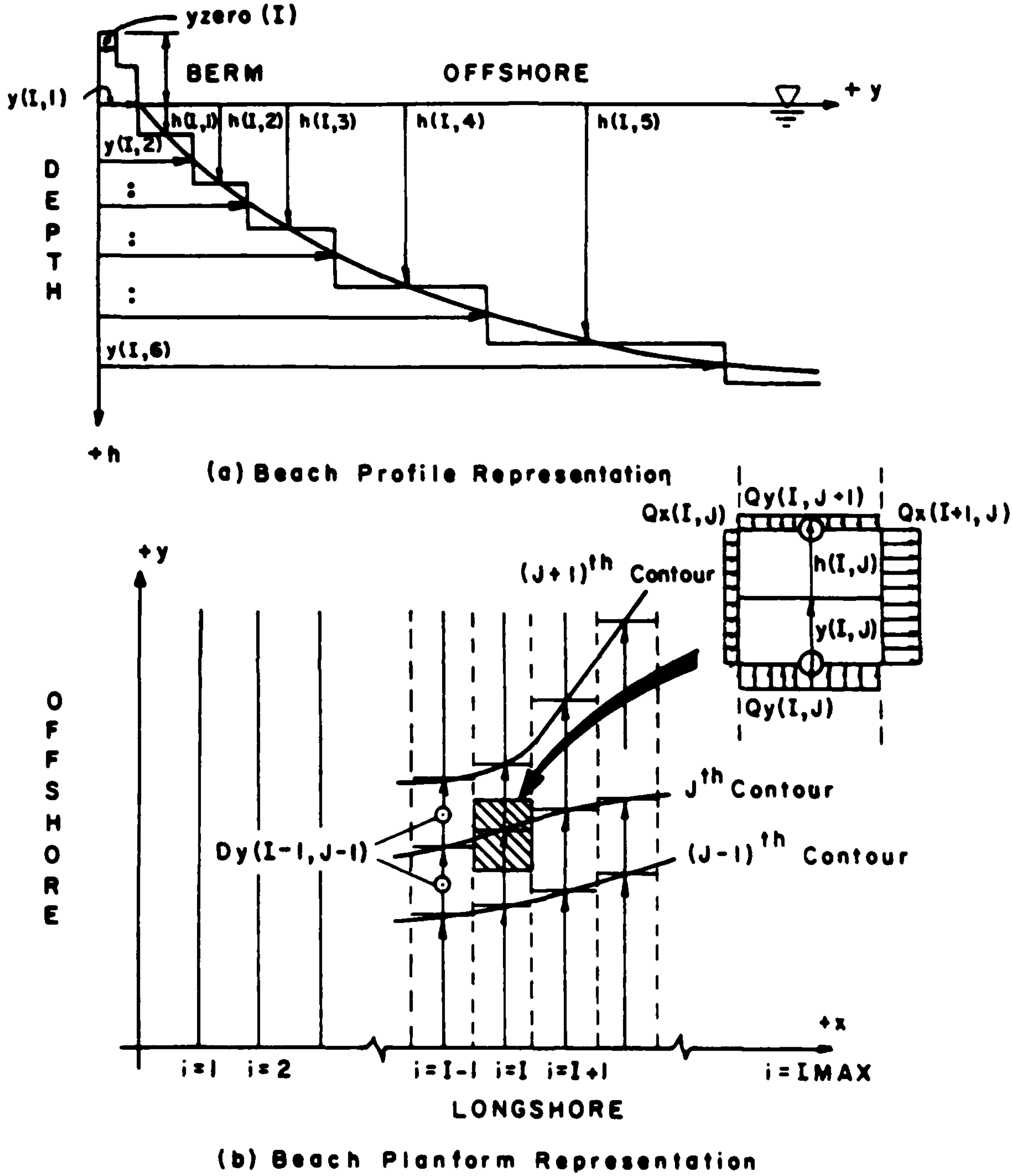

Figure 3. Definition sketch (from Perlin and Dean 1983)

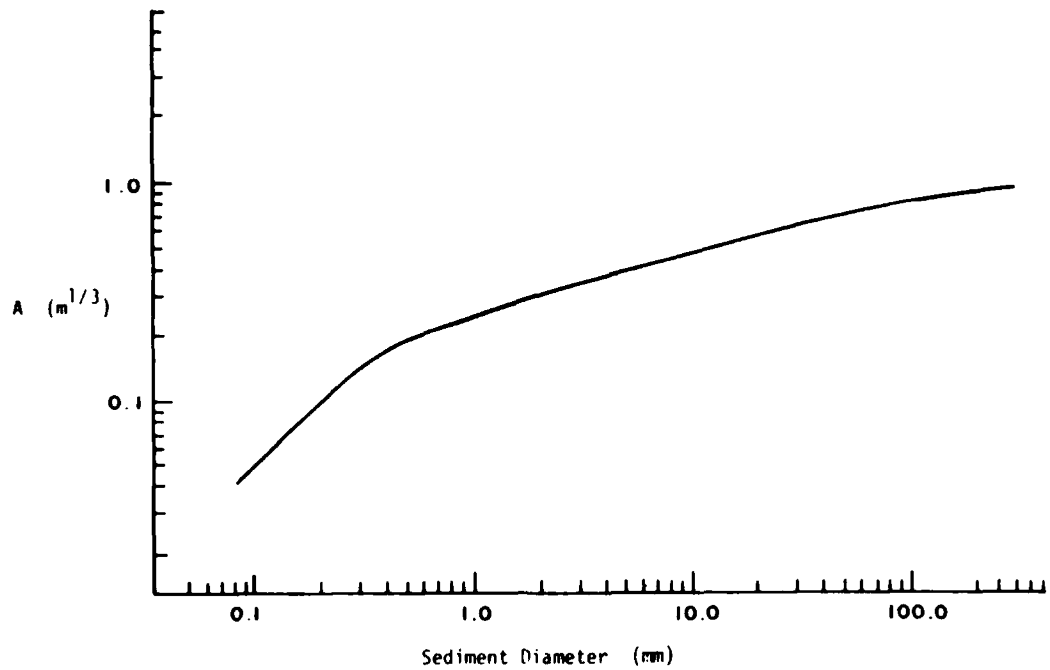

Figure 4. A versus sediment diameter (after Moore 1982)

d. COFF--The coefficient COFF linearly affects the magnitude of the onshore-offshore sediment transport. For example, doubling the COFF value will double Q_Y . The value used in Perlin and Dean (1983) and in all examples of this report is 0.00001. This program coefficient can be changed to achieve proper onshore-offshore sediment transport magnitudes.

e. CONST and CAPPA--These coefficients determine the value for the constant TKSI which linearly affects the magnitude of the total longshore transport. As in the COFF example, these coefficients can be altered to produce a desired total longshore sediment transport magnitude. The coefficients (lines 284 and 285 of the program) are currently set at 0.77 and 0.78.

f. An additional factor was introduced in the model to slow the shoreline response under certain design cases. This coefficient, Beach Response Factor, (BRF) is shown on lines 564, 565, and 566 of the program listing (Appendix B). The factor was set at 0.5 for the examples presented. This value can be replaced by 1.0, equivalent to the original listing, if the shoreline responds too slowly.

g. Additional constants such as density, beach slope, and porosity are defined in Perlin and Dean (1983) and can be located in the program listing.

22. Several examples are presented in this document to both demonstrate the capability of the model and allow the potential user the ability to verify that the model is operating correctly. Initially, five examples are

presented, three of which are taken from Perlin and Dean (1983). Complete input and output data are provided for each example in Appendix A. These cases are presented so that a user can become familiar with the model by applying known input data to reproduce known output data. This will also allow the user the opportunity of determining the model's response to varying certain of the model coefficients. A final example is presented which demonstrates the use of the interactive input data file generation program for the subsequent analysis of the Lakeview Park project in Lorain, Ohio. This actual example will show the simultaneous application of all of the N-line model capabilities. The five examples are:

a. Example 1--Single Jetty. The first example is for case 4.2a presented in Perlin and Dean (1983). Figure 5 is a reprint of the equilibrium planform along with input data. Sample input and output data after 30 iterations are shown in Appendix A.

b. Example 2--Multiple Jetties. Example 2 represents the multiple jetty example presented in Perlin and Dean (1983) as case 4.2c. Figure 6 shows the initial and final contours as presented by Perlin and Dean. Input and output data after 30 iterations are shown in Appendix A.

c. Example 3--Dredged Material Disposal. This simulation represents the single addition of dredged material disposal at the 7- and 11-ft contours according to the monthly incremental value used for case 2.c1 in Perlin and Dean (1983). Figure 7, reproduced from Perlin and Dean (1983), shows the equilibrium results for this case. Input and output data after 30 iterations are presented in Appendix A.

d. Example 4--Single Breakwater. This example, shown in Figure 8, shows a hypothetical case of a single detached offshore breakwater. Input variables for this case and a sample output after 30 iterations are shown in Appendix A.

e. Example 5--Double Breakwaters, Single Jetty. Figure 9 represents the fifth example which begins to demonstrate the use of multiple structures. This hypothetical case incorporates a single jetty, as in Example 1, with two detached breakwaters. Input and output data after 30 iterations are shown in Appendix A.

f. Example 6--Lakeview Park, Lorain, Ohio. A specific application of the model was made to the Lakeview Park project in Lorain, Ohio. This project incorporates all of the capabilities of the model in a single application. This design case, along with some of the problems associated with its computer simulation, is presented in Part V.

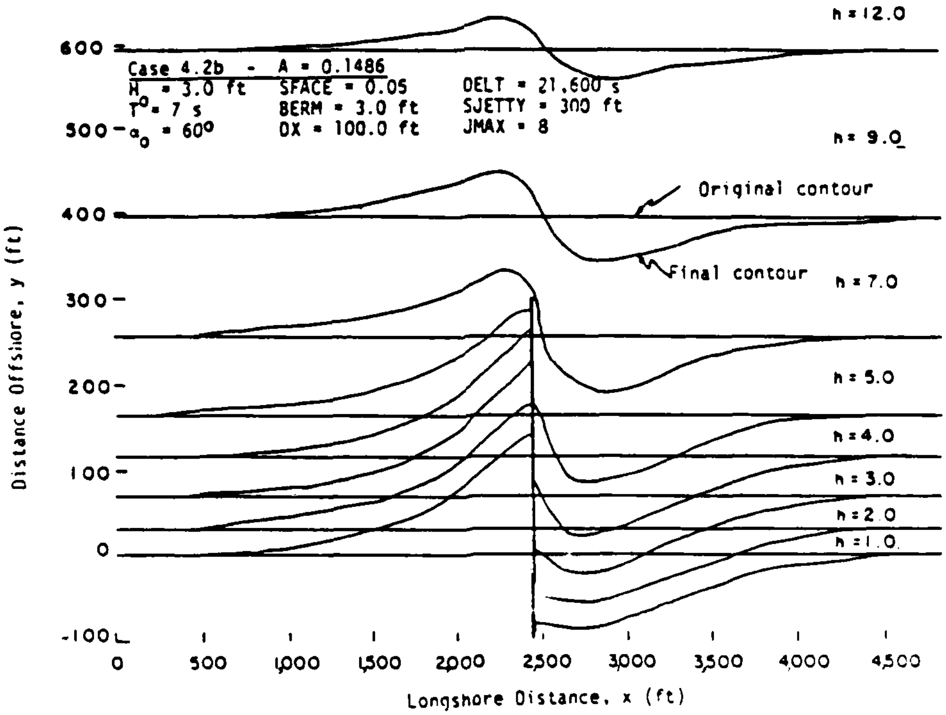

Figure 5. Single jetty (from Perlin and Dean 1983)

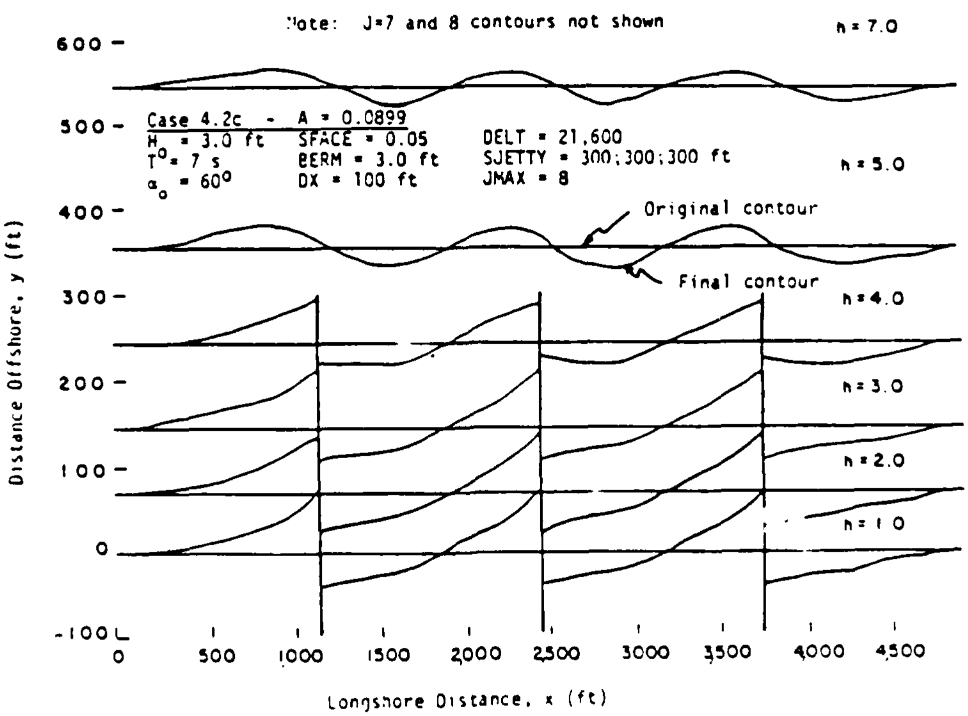

Figure 6. Multiple jetties (from Perlin and Dean 1983)

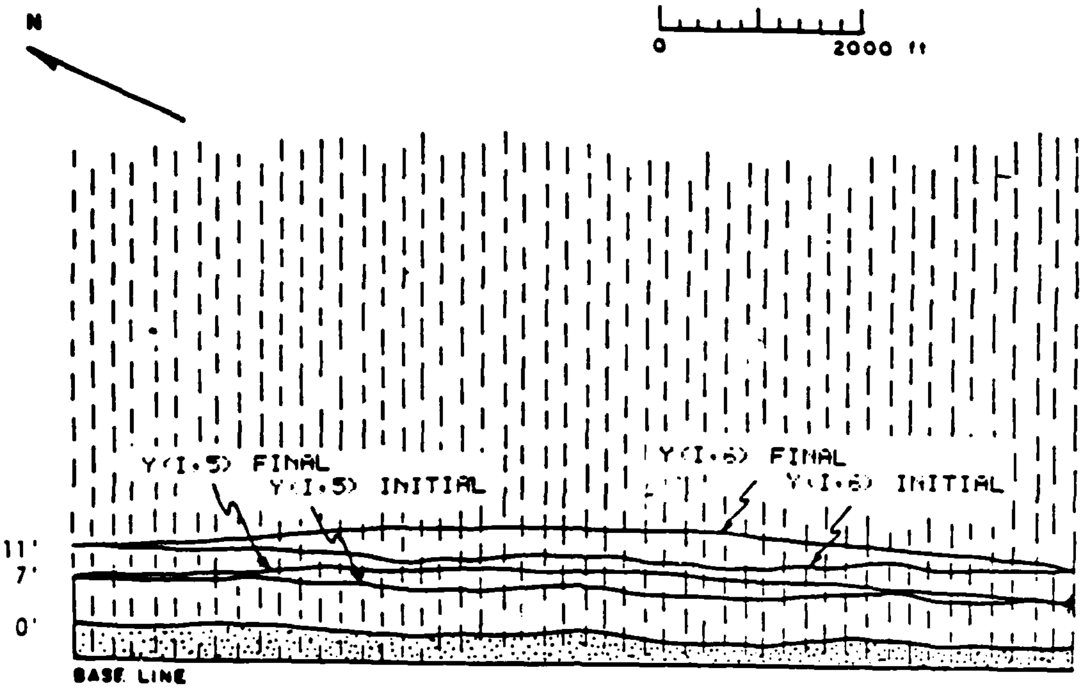

Figure 7. Dredged material disposal (from Perlin and Dean 1983)

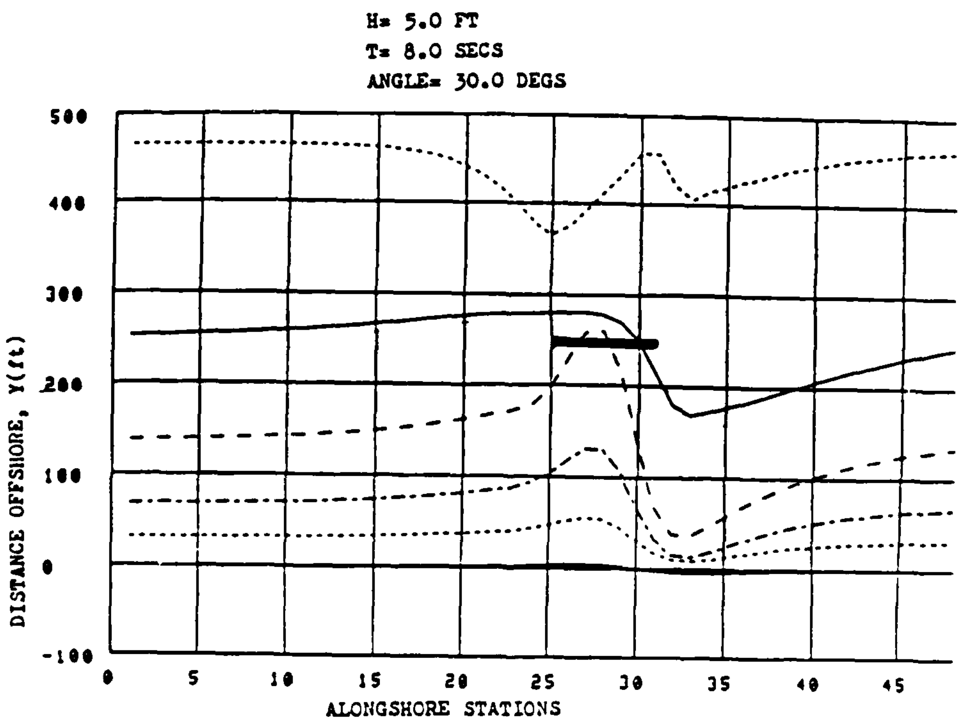

Figure 8. Single breakwater

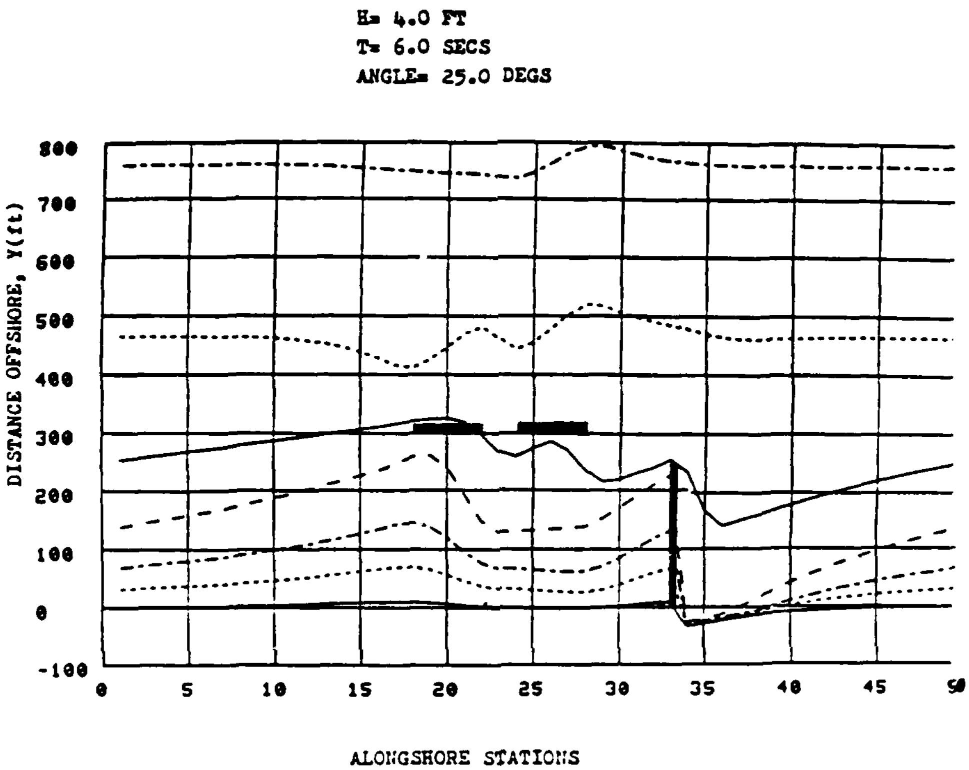

Figure 9. Double breakwaters, single jetty

PART V: MODELING LAKEVIEW PARK WITH THE N-LINE MODEL

23. When modeling an actual process, whether using an equation, a physical model, or a computer program, comparison of the model's output with a real-world result is necessary for verification of the model. This comparison can be in a qualitative and/or quantitative sense; if the modeling process is successful for one real situation, it is reasonable to expect successful results for other similar cases.

24. The N-line model has been verified in a qualitative sense, as presented in Figures 5-9 of this report. Lakeview Park, Lorain, Ohio, was modeled with the N-line program to compare the actual beach response of Lakeview Park with the model. This allows a quantitative evaluation of the model's adaptivity to specific conditions where a known response is expected.

Lakeview Park

25. Lakeview Park in Lorain, Ohio, is a project that has been monitored since its creation in 1977 by the Buffalo District and CERC. Lakeview Park has been a successful project, accreting approximately 3,000 cu yd of material per year (Pope and Rowen 1983). The site has a three-segmented detached breakwater, two groins, and placed fill, and, as such, utilizes most of the capabilities of the modified N-line model (see Figure 10). The beach fill was placed along 1,250 ft of shoreline, the two groins are 166 and 350 ft in length, and the detached breakwater has segments approximately 250 ft in length and 200 to 250 ft from the initial placed fill waterline.

26. The project has a large prototype data base, including bathymetric surveys for 1977-1982, aerial photographs from 1977-1982, hindcast and Littoral Environment Observation (LEO) wave data for the area, and data from a physical model study (Bottin 1982). The prototype aerial photographs of Lakeview Park were digitized, and a set of shorelines were plotted that represent the stabilized project shoreline, creating an envelope of shorelines that was compared with the model's output (see Figure 11). Thus, the prototype data from Lakeview Park were used to conduct verification tests of the N-line model. In this way the N-line model could be used for a situation where the beach response was well known.

Figure 10. Aerial photograph of Lakeview Park, Lorain, Ohio, 8 Sep 1980. Scale: 1 in. = 4,800 ft

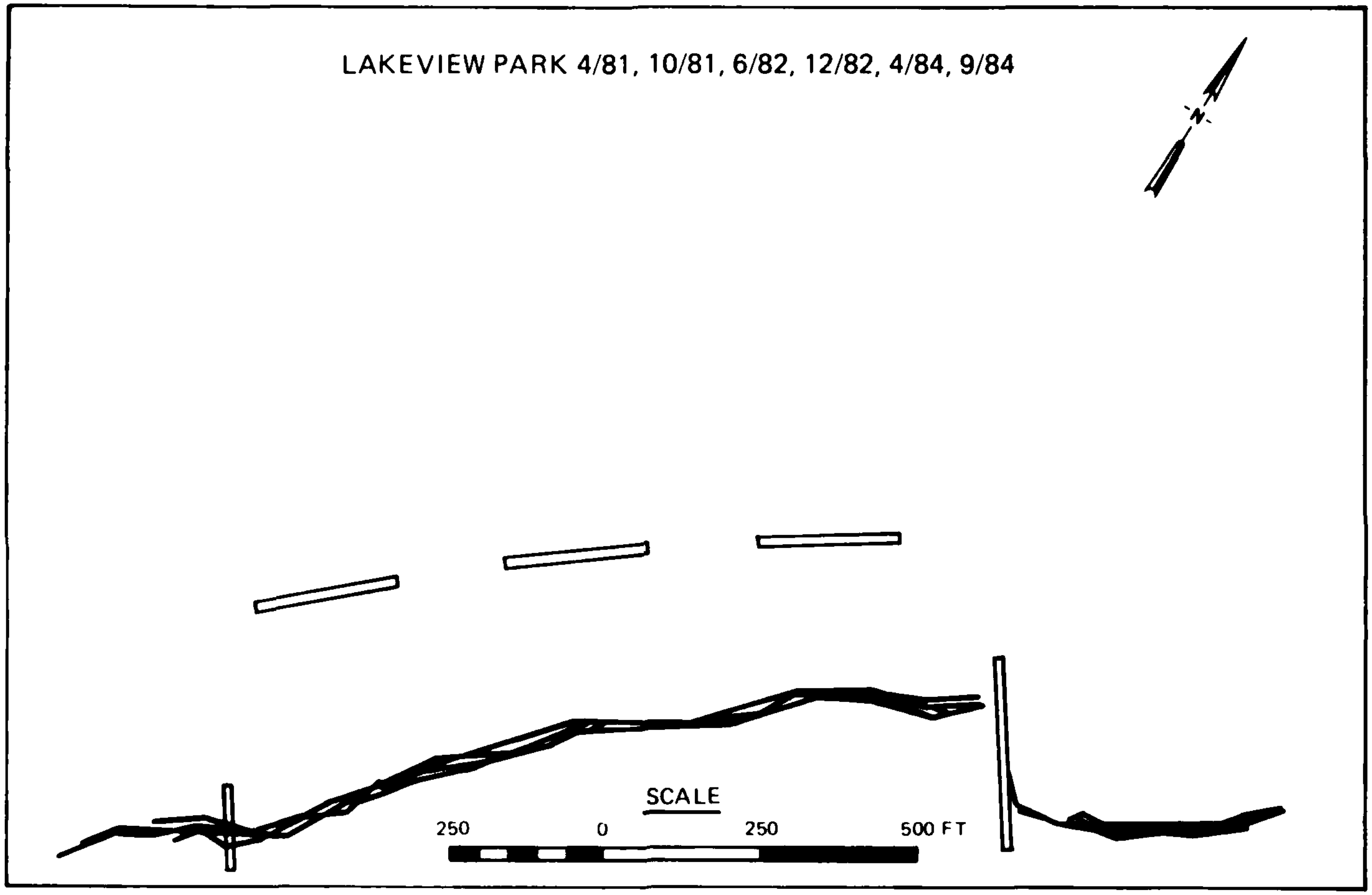

Figure 11. Stabilized project shoreline, 1981-1984 (digitized from aerial photographs)

Model Input Conditions

27. For the Lakeview Park example presented herein, hindcast wave data (Saville 1953) were reduced to obtain representative values of wave height, period, direction, and percentage of time from a particular direction. The 10 wave conditions that resulted agreed reasonably well with the LEO data. These 10 wave conditions were repeated and used in all the Lakeview Park cases presented. A single wave condition from a single direction is not a true prototype occurrence and could generate unrealistic responses in the model, or cause the model to "blow up."

28. The initial project contour locations that were used for each model run are presented in Figure 12. The initial shoreline was calculated by measuring the distance from the baseline to the approximate waterline based on the as-constructed condition. Since the model assumes equilibrium profiles at each I-grid shoreline point, the Lakeview Park fill area (on a linear slope) was simulated using the model's disposal option, creating a file called SPOOL that contains the I,J-location and the amount of fill to be added to the average of each two adjacent contours (see Figure 13). The model uses the average depth between adjacent contours in all calculations.

29. The value of ADEAN can be calculated using the equations presented in Figure 4, which gives ADEAN in metres$^{1/3}$. ADEAN as used in the model is in units of feet$^{1/3}$; the value of D_{50} = 0.22 mm (the grain size of the placed fill) was used, giving a value of ADEAN = 0.15 ft$^{1/3}$.

30. The selection of a time-step of 6 hr and a space-step of 50 ft was the result of an interactive analysis. A larger space-step would give ample distance for the contours to return to their boundary conditions (problems arise if the project ends are too close to the boundaries), but would not show much detail in the project area. A small space-step requires a small time-step and a large number of x-grid points, and therefore is costly to run. Several combinations of time-steps and space-steps were attempted, some resulting in unrealistic responses from the model, until the values presented here were selected. The interactive file generator is shown in Figure 14. The input files are presented in Figures 15 and 16.

31. Since the sediment transport from the west into the prototype area is small, the contours west of the smaller groin were modeled to move no sediment in the longshore direction by changing the N-line model code.

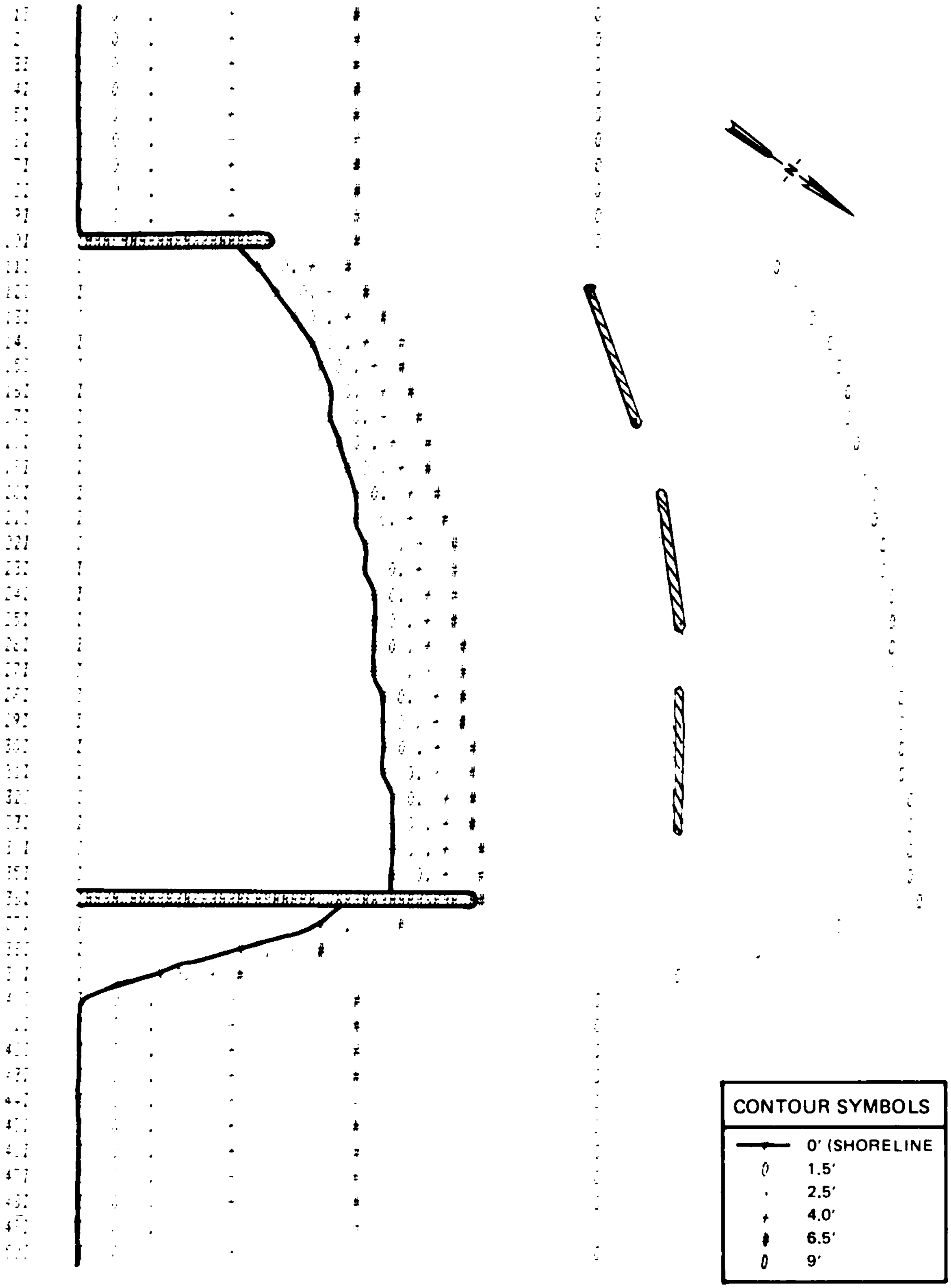

Figure 12. Initial project contour locations used for each model run, t = 0 days

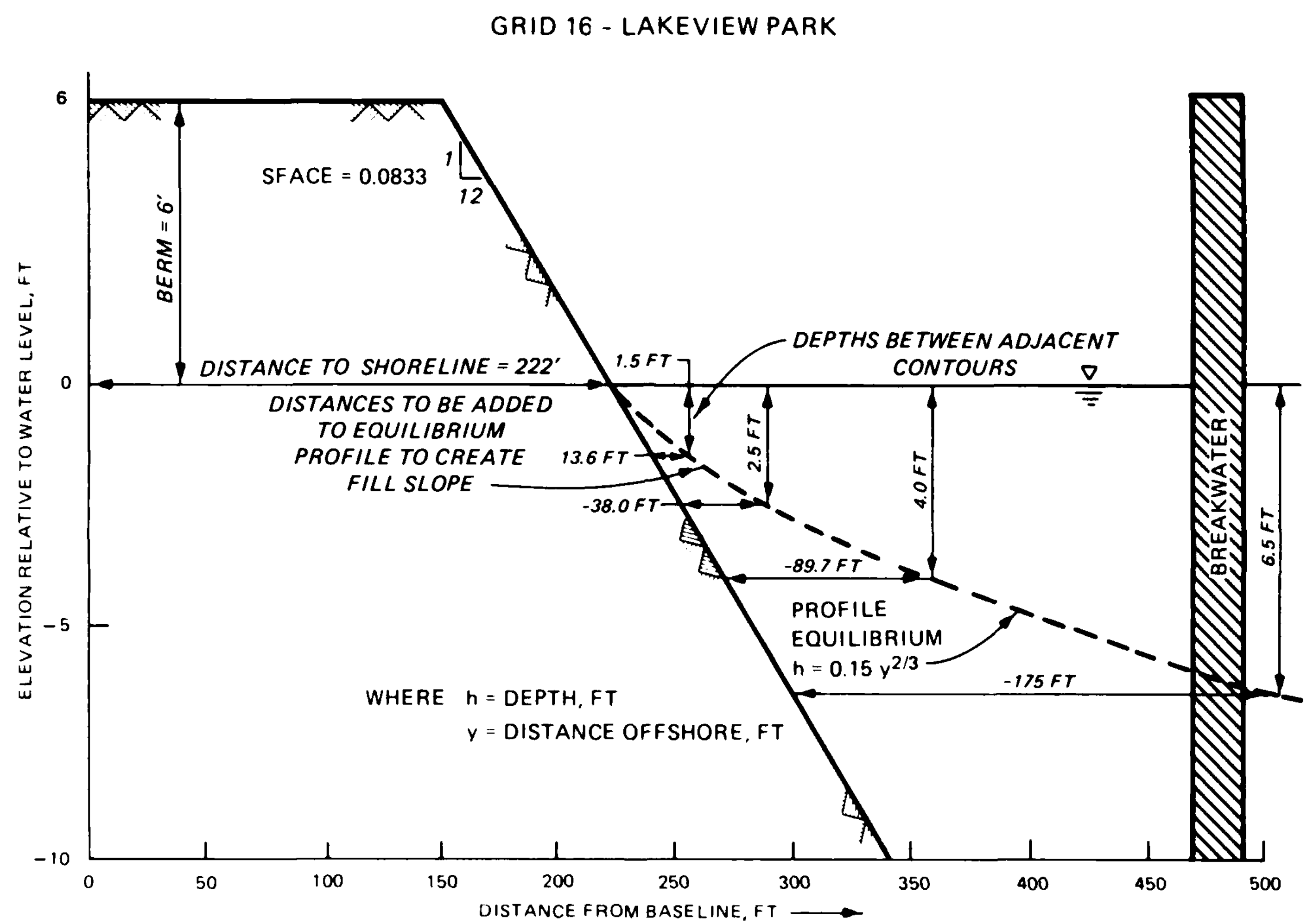

Figure 13. Example grid profile and distance to be added to equilibrium profile to get fill slope (creating file SPOOL)

```
[illegible]
[illegible]
     0.389 CP SECONDS COMPILATION TIME.
/EOD
ENTER IMAX
 [illegible]
ENTER JMAX
 [illegible]
ENTER THE OFFSHORE BOUNDARY CONTOUR DEPTH IN METERS [illegible]
 [illegible]
ENTER THE DESIRED CONTOUR DEPTHS IN [illegible]
 1.,2.,3.,5.,7.,11.,14.,17.,[illegible]
ENTER THE DESIRED FREQUENCY [illegible] OUTPUT
[illegible]
 [illegible]
[illegible]
```

.

.

.

.

.

```
[illegible]
```

Figure 14. Interactive file generator (Continued)

```
ENTER NO. 1 BREAKWATER LEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE(FT)
 12,17,460,500
ENTER NO. 2 BREAKWATER LEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE(FT)
 20,25,520,540
ENTER NO. 3 BREAKWATER LEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE(FT)
 28,33,540,540
DO YOU WISH TO ADJUST THE LOCATIONS OF ANY
CONTOURS?  ENTER 0 FOR NO OR 1 FOR YES
 1
AT WHAT TIME INTERVAL WILL THE CONTOURS BE ADJUSTED?
 1
ENTER I,J VALUE, INCREMENTAL VALUE TO BE ADDED
TO THE AVERAGE OF EACH ADJACENT CONTOUR(FT). ENTER IMAX,JMAX
VALUES,0. WHEN COMPLETE
 [illegible]
 [illegible]
      •
      •
      •
      •
 [illegible]
 [illegible]
 [illegible]
 0,0,0
[illegible]
AND [illegible] OF THAT WAVE [illegible]. WHEN COMPLETED,
[illegible]
 [illegible]
 [illegible]
 [illegible]
 [illegible]
 [illegible]
      •
      •
      •
      •
 [illegible]

 [illegible] TIME.
 [illegible]

 [illegible]
```

Figure 14. (Concluded)

```
   50        3   IMAX, JMAX
        10.000   WDEPTH (meter)
 1.000   2.000   3.000   5.000   7.000  11.000  14.000  17.000  25.000  32.300 } Contour Depths (feet)
  .000    .000    .000    .000    .000    .000    .000    .000    .000    .000 }
   20 ← Number of Iterations between printouts
       6.000    .0833    .220   Berm height (ft), slope, grain diameter (mm)
 2 ← Number of Groins
10   100.000 } I-location, length of groin (ft)
36   350.000 }
  .1500   ADEAN, ft^1/3
 50.000 21600.000  space step (ft), time step (sec)
   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00 } Initial shoreline:
165.00  190.00  195.00  210.00  216.00  222.00  228.00  234.00  240.00  246.00 }    Distances from baseline (ft)
252.00  258.00  260.00  262.00  264.00  266.00  268.00  270.00  272.00  274.00 }
276.00  278.00  280.00  282.00  284.00  286.00  214.50  143.00   71.50     .00 }
   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00 }
  3  ← Number of Breakwaters
              12        17     460.00   500.00 } Breakwaters:
              20        25     520.00   540.00 }  Right location, left location, distance offshore right side,
              28        33     540.00   540.00 }        distance offshore left side
  1        1.5   3.1   35.7     1 ← Code meaning fill added at this time-step
  2        2.5   4.2   60.0     0
  3        2.5   4.2   33.0
  4        3.5   5.1   38.0     0
  5        4.5   5.7   38.0     0
  6        2.5   4.0   15.0     0   Fill not added
  7        1.5   2.9   -8.0     0
  8        1.5   2.9   15.0     0
  9        2.5   4.0   -8.0     0
 10        1.5   2.9  -30.0     0
 11        2.5   3.1   33.0     0
 12        2.5   4.2   60.0     0
 13        2.5   4.2   38.0     0
 14        2.5   5.1   38.0     0
 15        2.5   5.7   38.0     [illegible]
 16        2.5   4.0   15.0     0
 17        1.5   2.9   -3.0     0
 18        1.5   2.9   15.0     0
 19        1.5   4.0   -8.0     0
 20        1.5   2.9  -30.0     [illegible]
                  •
                  •                  Wave Conditions:
                  •                    wave height (ft), period (sec), angle (deg)
                  •
112        2.5   4.2   60.0     [illegible]
113        2.5   4.2   33.0     [illegible]
114        2.5   5.1   38.0     0
115        2.5   5.7   38.0     0
116        2.5   4.0   15.0     [illegible]     (Ten Wave Conditions Repeated)
117        1.5   2.9   -8.      0
118        1.5   2.9   15.0     0
119        1.5   4.0   -8.0     0
120        1.5   2.9  -30.0     0
121       99.0  99.0   99.0     0
```

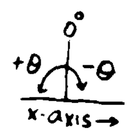

Figure 15. INPUT file (this file generated Figure 7)

11	2	-13.60
12	2	-13.60
13	2	-13.60
14	2	-13.60
15	2	-13.60
16	2	-13.60
17	2	-13.60
18	2	-13.60
19	2	-13.60
20	2	-13.60
21	2	-13.60
22	2	-13.60
23	2	-13.60
24	2	-13.60
25	2	-13.60
26	2	-13.60
27	2	-13.60
28	2	-13.60
29	2	-13.60
30	2	-13.60
31	2	-13.60
32	2	-13.60
33	2	-13.60
34	2	-13.60
35	2	-13.60
36	2	-13.60
37	2	-13.60
38	2	-13.60
39	2	-13.60
11	3	-38.00
12	3	-38.00
13	3	-38.00
14	3	-38.00
15	3	-38.00
16	3	-38.00
17	3	-38.00
18	3	-38.00
19	3	-38.00
20	3	-38.00
21	3	-38.00
22	3	-38.00
23	3	-38.00
24	3	-38.00
25	3	-38.00
26	3	-38.00
27	3	-38.00
28	3	-38.00
29	3	-38.00
30	3	-38.00
31	3	-38.00
32	3	-38.00
33	3	-38.00
34	3	-38.00
35	3	-38.00
36	3	-38.00
37	3	-38.00
38	3	-38.00
39	3	-38.00
11	4	-89.70
12	4	-89.70
13	4	-89.70
14	4	-89.70
15	4	-89.70
16	4	-89.70
17	4	-89.70
18	4	-89.70
19	4	-89.70
20	4	-89.70
21	4	-89.70
22	4	-89.70
23	4	-89.70
24	4	-89.70
25	4	-89.70
26	4	-89.70
27	4	-89.70
28	4	-89.70
29	4	-89.70
30	4	-89.70
31	4	-89.70
32	4	-89.70
33	4	-89.70
34	4	-89.70
35	4	-89.70
36	4	-89.70
37	4	-89.70
38	4	-89.70
39	4	-89.70
11	5	-175.00
12	5	-175.00
13	5	-175.00
14	5	-175.00
15	5	-175.00
16	5	-175.00
17	5	-175.00
18	5	-175.00
19	5	-175.00
20	5	-175.00
21	5	-175.00
22	5	-175.00
23	5	-175.00
24	5	-175.00
25	5	-175.00
26	5	-175.00
27	5	-175.00
28	5	-175.00
29	5	-175.00
30	5	-175.00
31	5	-175.00
32	5	-175.00
33	5	-175.00
34	5	-175.00
35	5	-175.00
36	5	-175.00
37	5	-175.00
38	5	-175.00
39	5	-175.00
50	0	.00

I-GRID Point

Contour Level to add fill
'2' = average of 1 and 2 contour depths
'3' = average of 2 and 3 contour depths
'4' = " " 3 and 4 " "
'5' = " " 4 and 5 " "
etc.

Distance to be added to contour level

Figure 16. SPOOL file (used in all model runs except Figure 18)

32. The parameter in the N-line model code that controls the rate of shoreline movement, the BRF, was set at 1.0 (BRF = 1.0).

Model Output

33. The model was run using the input configuration described for a period of 360 days; printouts are included at 30 days (Figure 17), 180 days (Figure 18), and 360 days (Figure 19). Notice that the model never reaches the equilibrium shoreline as shown in Figure 11; the shoreline keeps eroding. The outer contours show a greater sinuosity than the inner contours; this is because of the small slope of the equilibrium profile as distance offshore increases. As in the prototype, the model's shoreline on the west end erodes more quickly than the east end. However, since the sinuosity of the model's shoreline is much less than in the prototype, it is difficult to see the influence of the individual breakwater segments which was obvious in the prototype.

34. After the model was run for the original configuration of structures at Lakeview Park, eight different configurations were run for 30 days. Each of these runs can be compared with Figure 17 to see how different structure configurations influence the project area; except for the change in structures, all model input parameters have been held constant. These runs are presented in Figures 20-27.

Discussion

35. In Figure 22, the run with four short-length breakwater segments and two groins, the model acts unrealistically, eroding the project severely at the east end. Figure 23 shows a run with four longer length break-water segments which appear to respond more realistically when performing as a long, single breakwater (compare with Figure 24). Therefore, the number of breakwater segments does not cause unrealistic response in the model. In comparing Figure 22 (short-length breakwater segments and two groins) with Figure 20 (two groins, no breakwater), one can see that the addition of the breakwater causes more erosion than the run without the breakwater. Apparently, the reflected waves around each segment in the four short-breakwater segment case interact and create a focusing of wave energy on the shoreline.

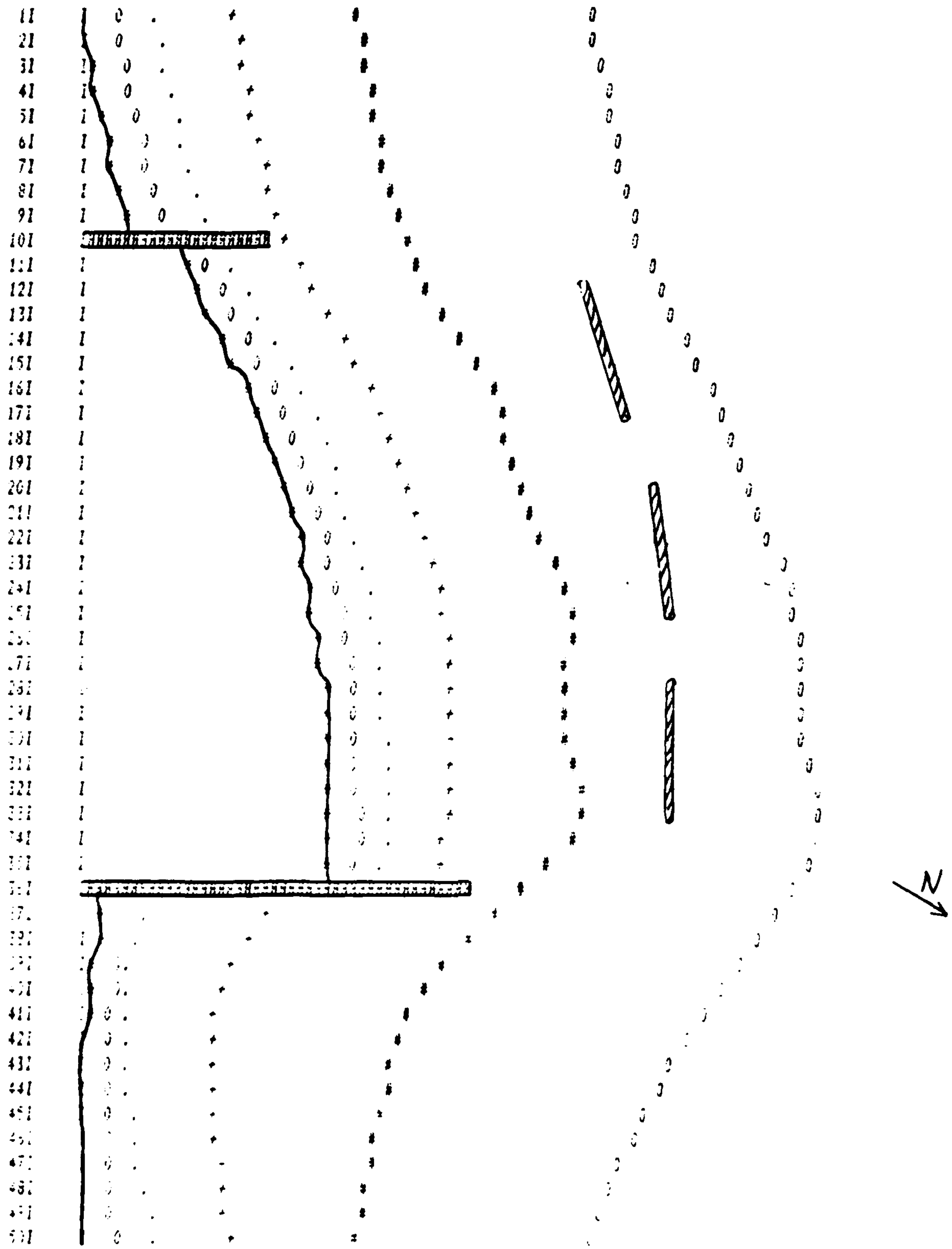

Figure 17. Prototype configuration at t = 30 days

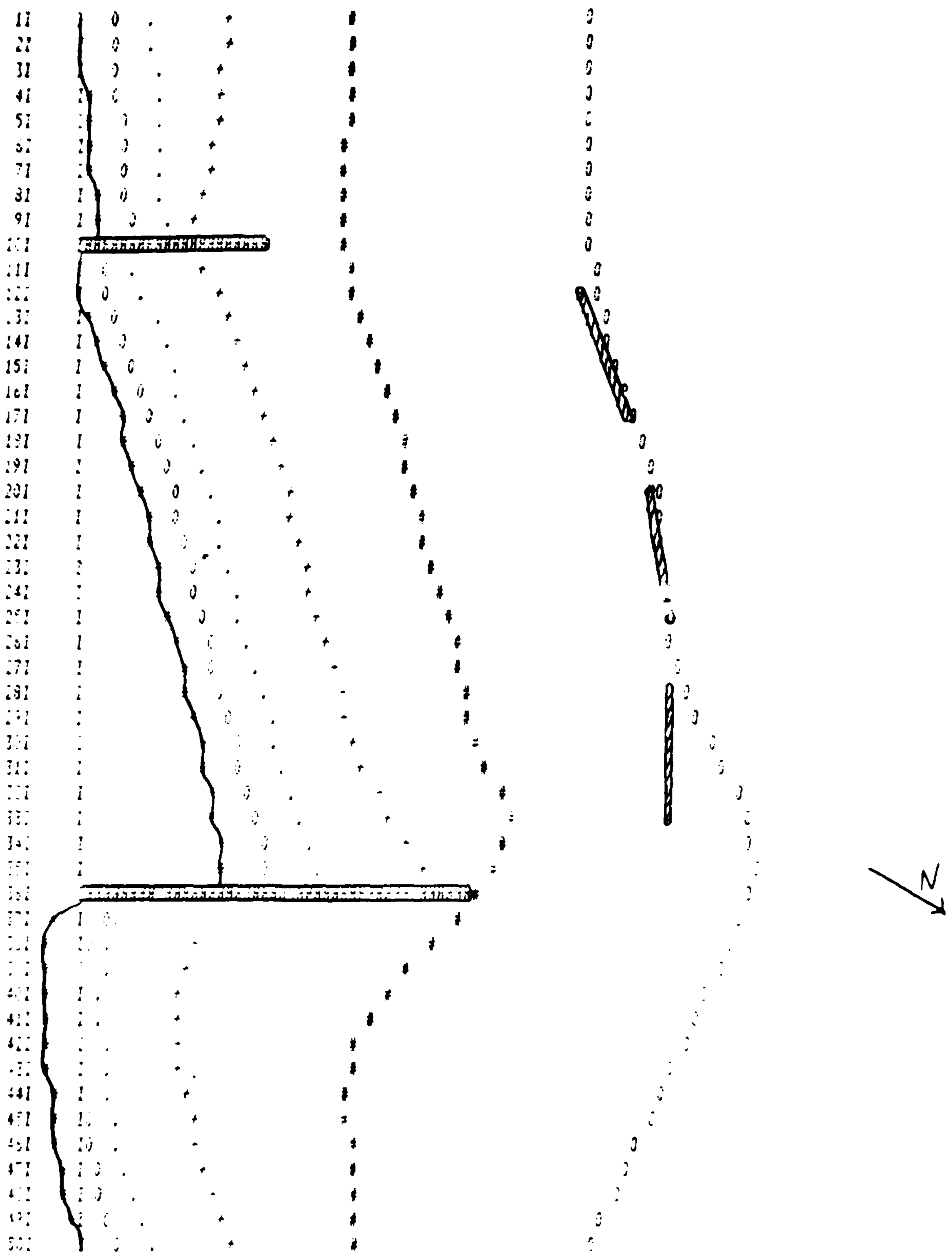

Figure 18. Prototype configuration at t = 180 days

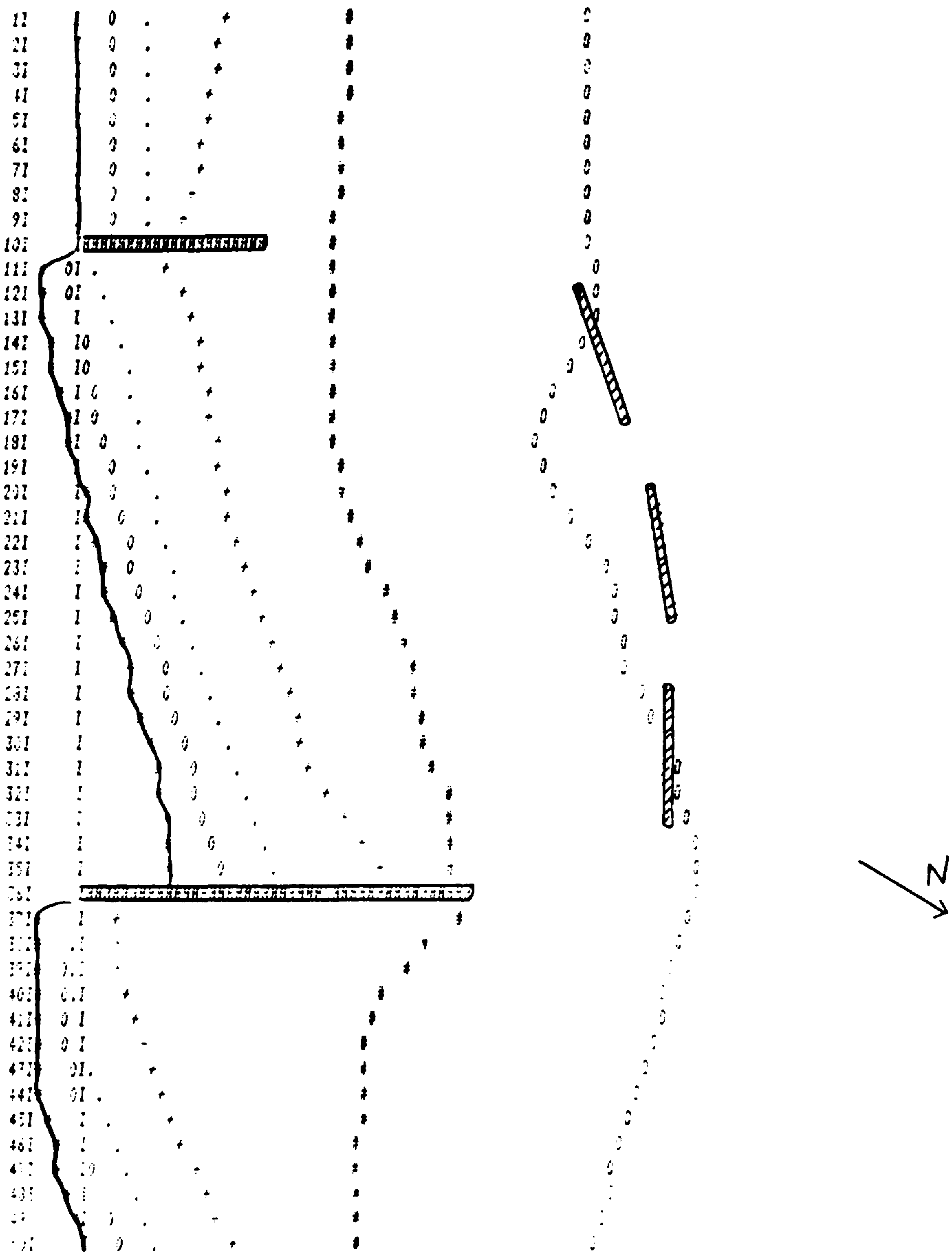

Figure 19. Prototype configuration at t = 360 days

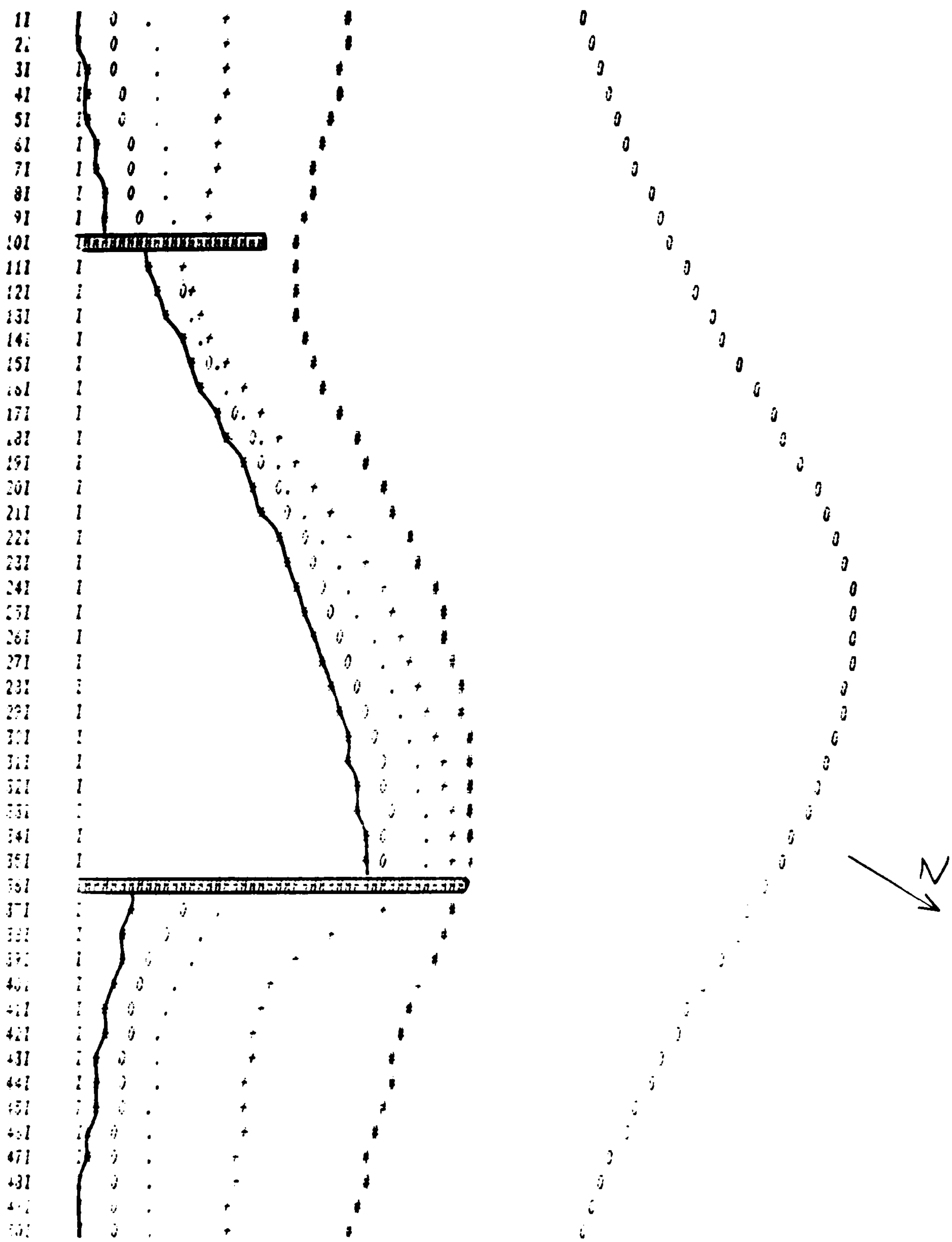

Figure 20. Two groins, no breakwater, t = 30 days

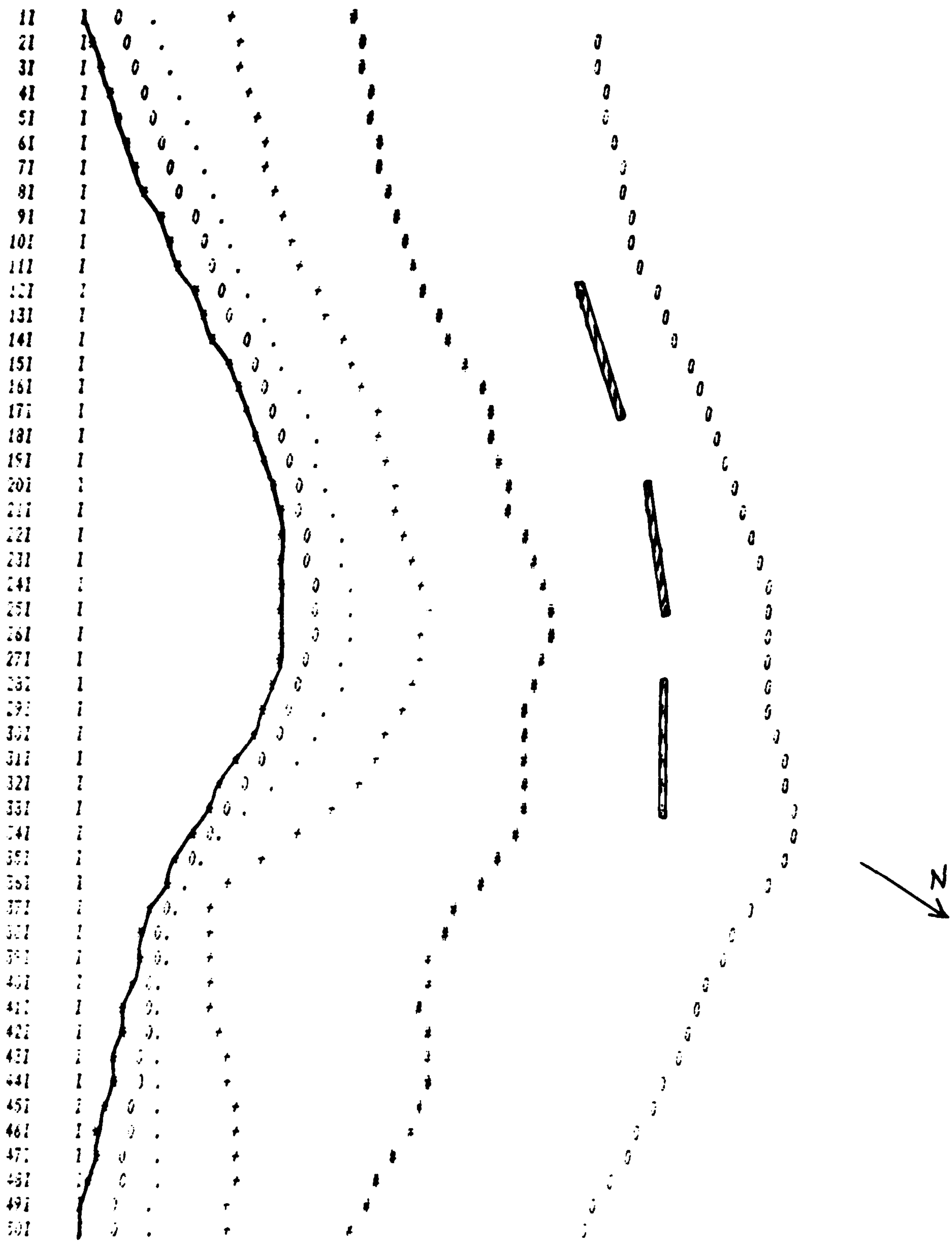

Figure 21. Three segment breakwater, no groins, t = 30 days

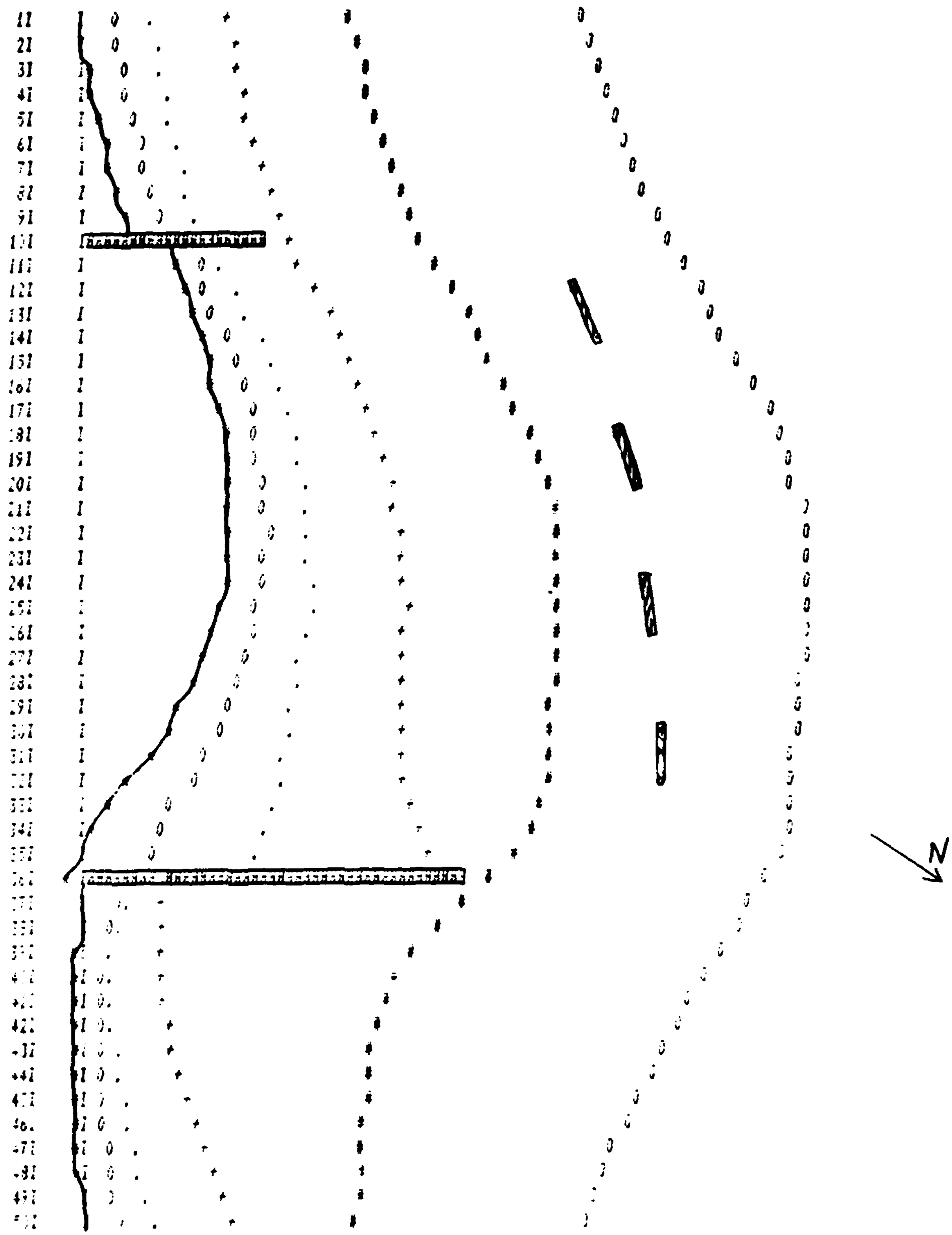

Figure 22. Four short-length breakwater segments, two groins, t = 30 days

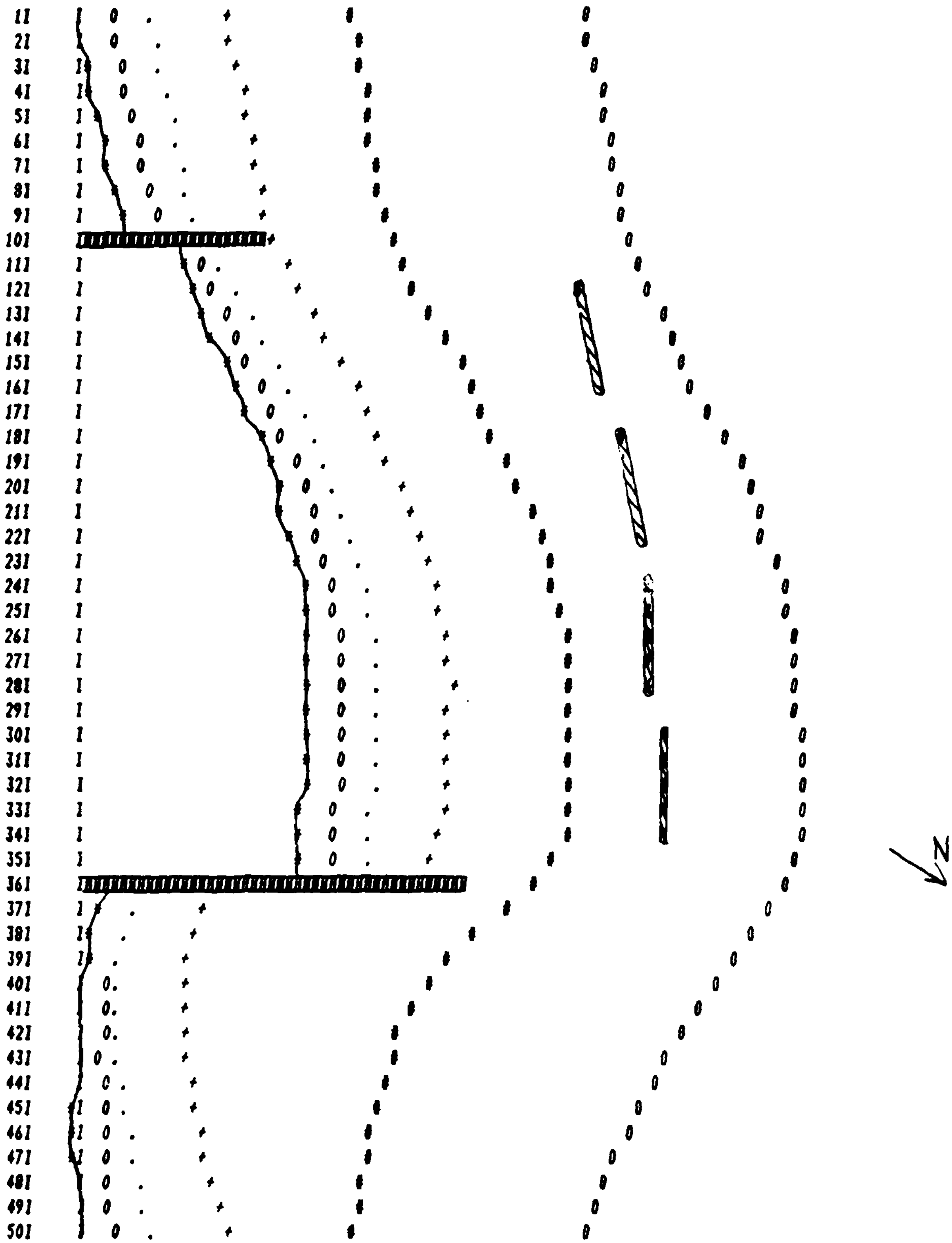

Figure 23. Four longer length breakwater segments, two groins, t = 30 days

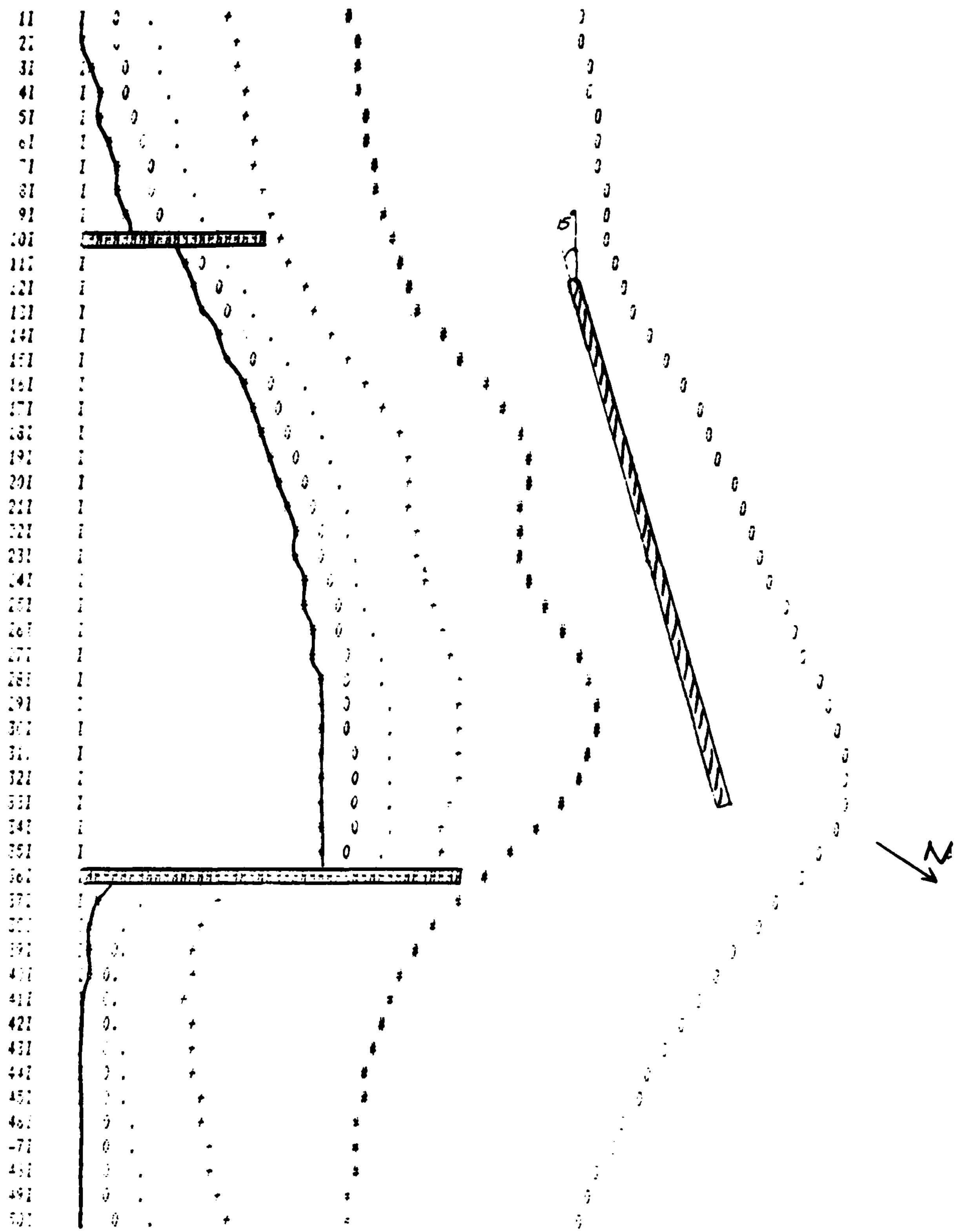

Figure 24. One breakwater, 15 deg offshore from baseline, two groins, t = 30 days

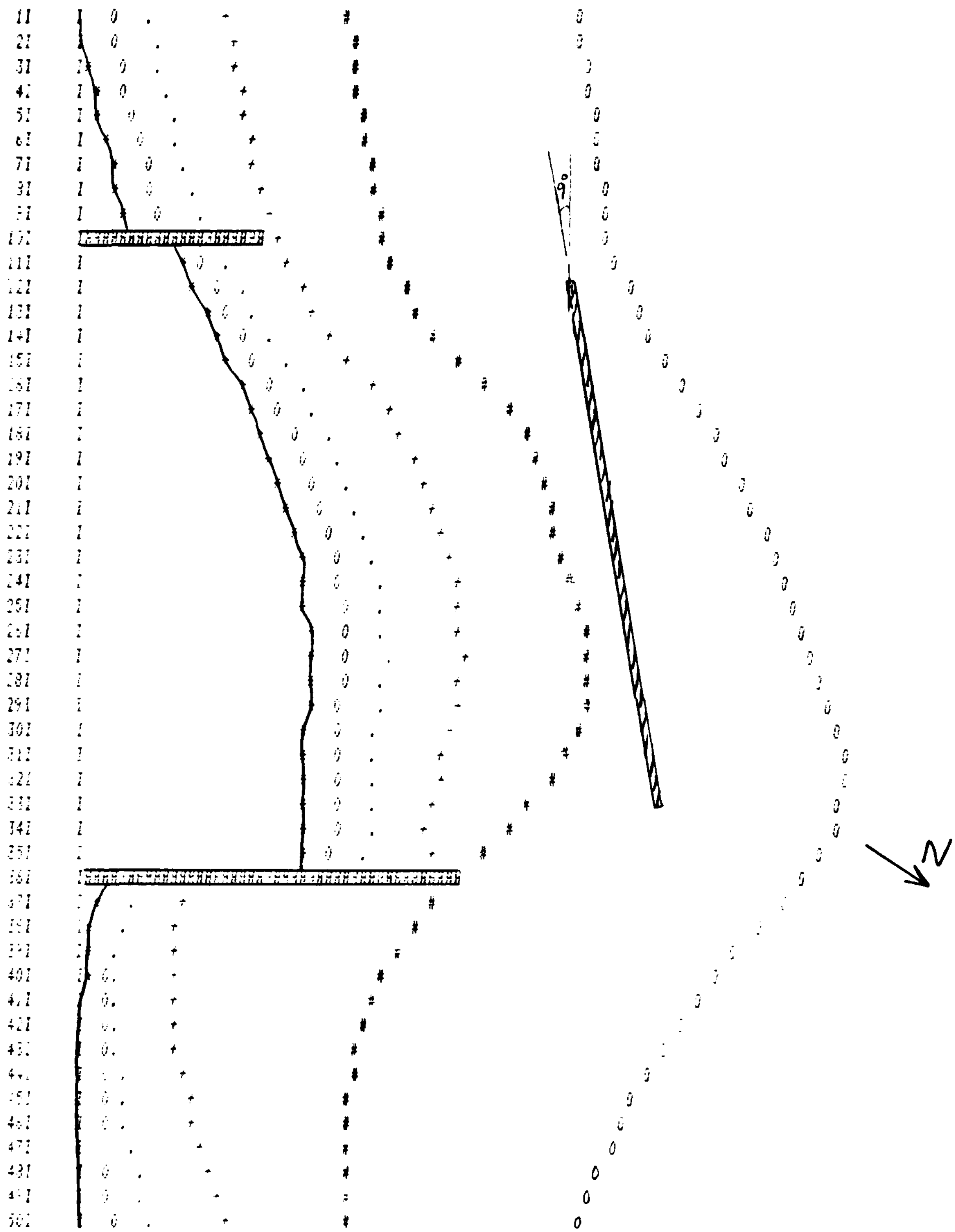

Figure 25. One breakwater, 9 deg offshore from baseline, two groins, t = 30 days

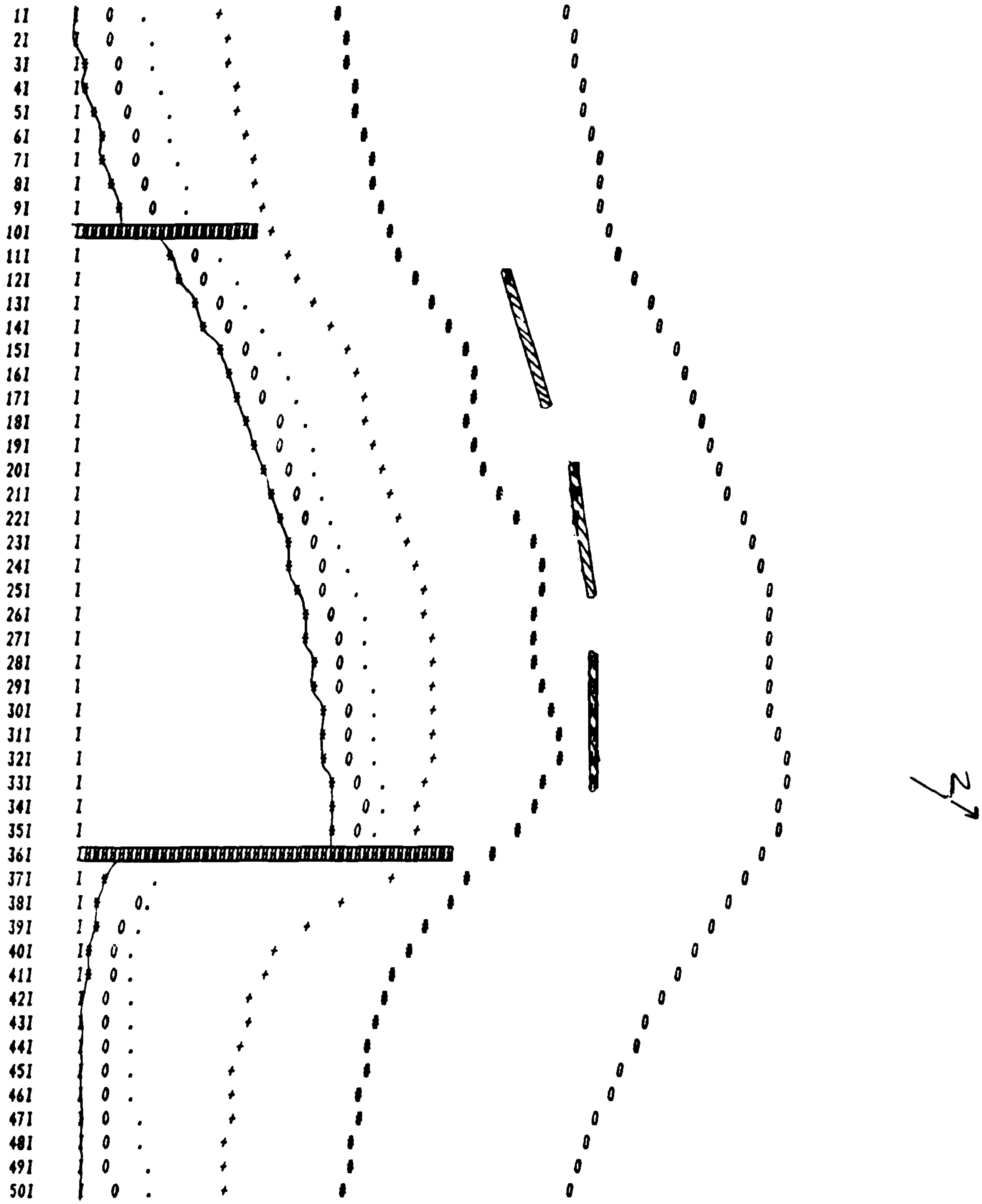

Figure 26. Three breakwater segments, 50 ft closer to shoreline, two groins, t = 30 days

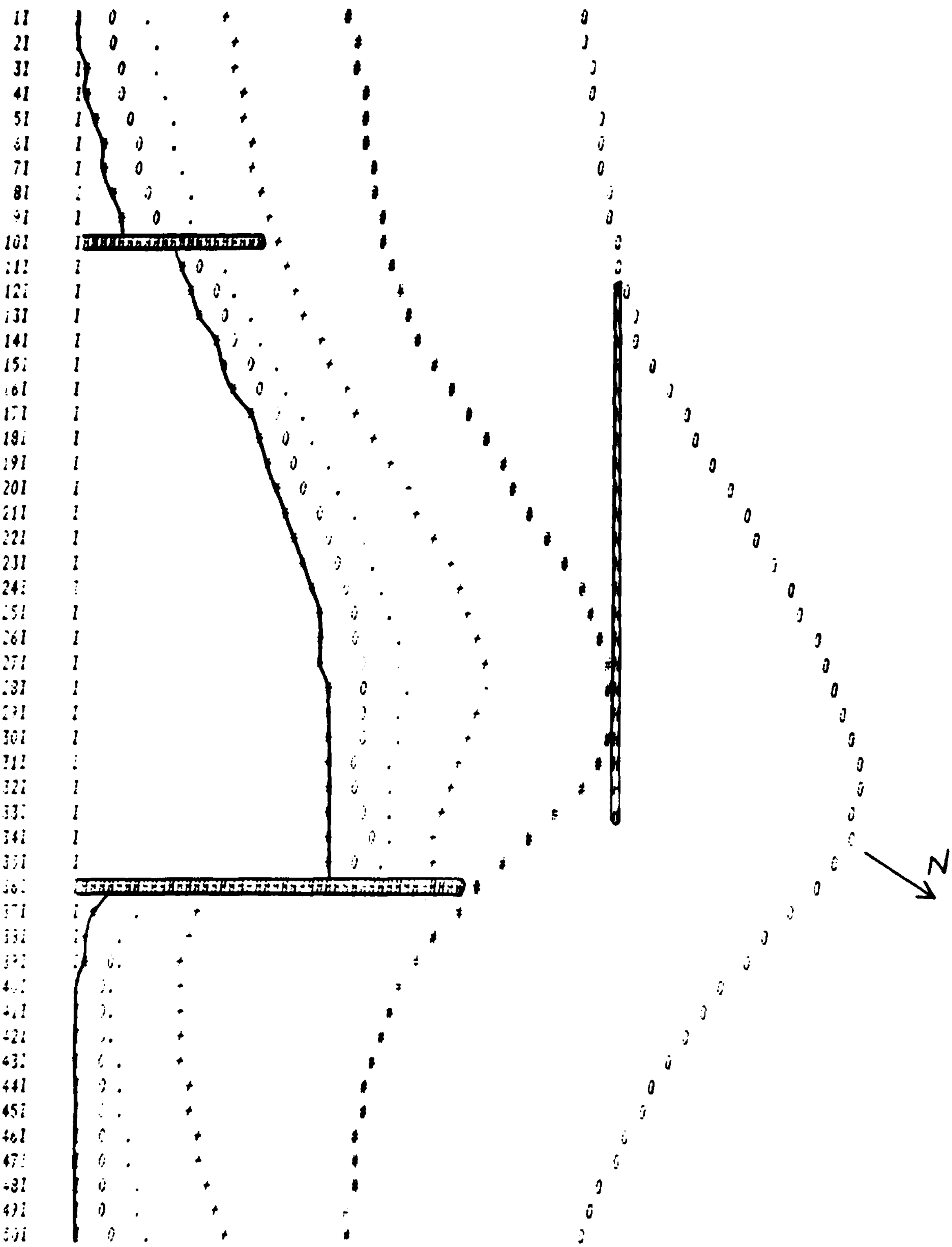

Figure 27. One breakwater parallel to baseline, two groins, t = 30 days

36. In Figure 26, the breakwater segments were moved 50 ft closer to shore. In comparing Figures 26 and 17, it is apparent that the contours did not change at all when the breakwater segments were moved closer to shore.

37. The two model responses described above are not logical and indicate that the program can only realistically model certain simple configurations. The user should be wary of accepting the model's output at face value, and should experiment with different configurations as was done here to determine the model's sensitivity to the user's particular setup. The breakwater addition to the model was written for use with structures that are located shore-parallel or near-parallel. Angled structures alone or connected to shore-parallel structures are not intended for use with the N-line model.

38. The choice of the initial shoreline position may appear arbitrary to the model user; however, the initial beach conditions greatly influence the model's output. A run was made using an initial shoreline on the baseline ((I,J) = 0.0). Fill was then added to create the same initial configuration as presented in Figure 12. However, after 30 days the model gave an entirely different result than when using an initial shoreline defined at the waterline (compare Figures 26 and 28). This discrepancy results because the model's rate of erosion is calculated from the difference between the waterline location after the fill has been added, and the initial shoreline location before the fill is added; the larger this distance, the faster the erosion rate.

39. In experimenting further with the model, two conditions used in simulating Lakeview Park, the BRF and the restriction of longshore transport across the west groin, were adjusted in the model code. Both of these conditions were observed as greatly influencing the model's output.

40. Figure 28 was a run made for 360 days with the BRF changed to 0.5 while continuing to restrict transport across the west groin. The amount of beach at 360 days is much greater with BRF = 0.5 than when BRF = 1.0 (compare Figures 29 and 19). This factor controls the rate of transport.

41. Figure 30 was a run for 360 days with the BRF kept at 0.5, but longshore transport was allowed across the west groin. Note that this run did reach an equilibrium point (compare with Figure 31, the same run at 300 days). However, the beach planform is not sinuous at all, and the cutback at the west groin is not apparent as it is in the prototype.

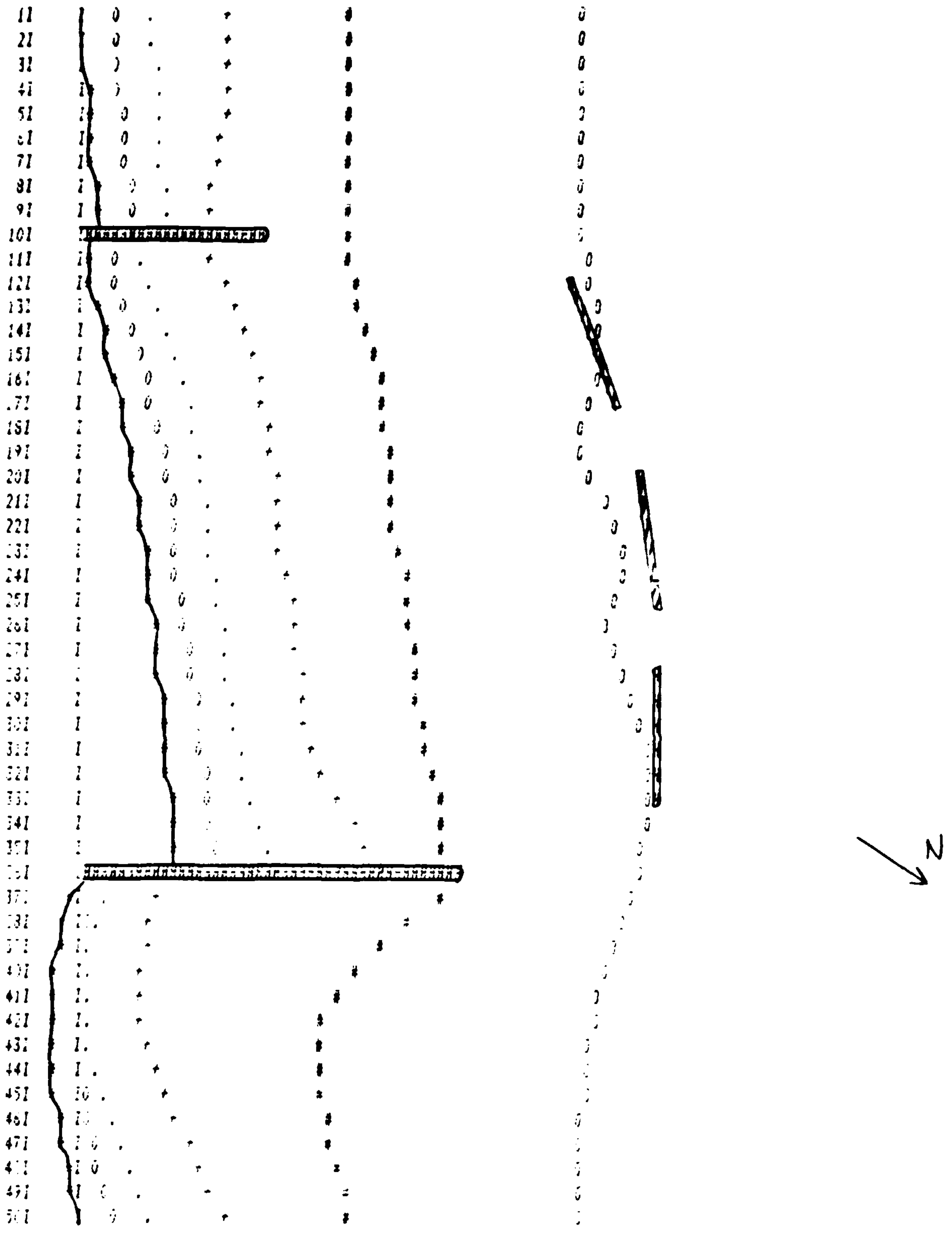

Figure 28. Model at t = 30 days; initial shoreline = 0.0; fill added to create initial contour locations as in Figure 1

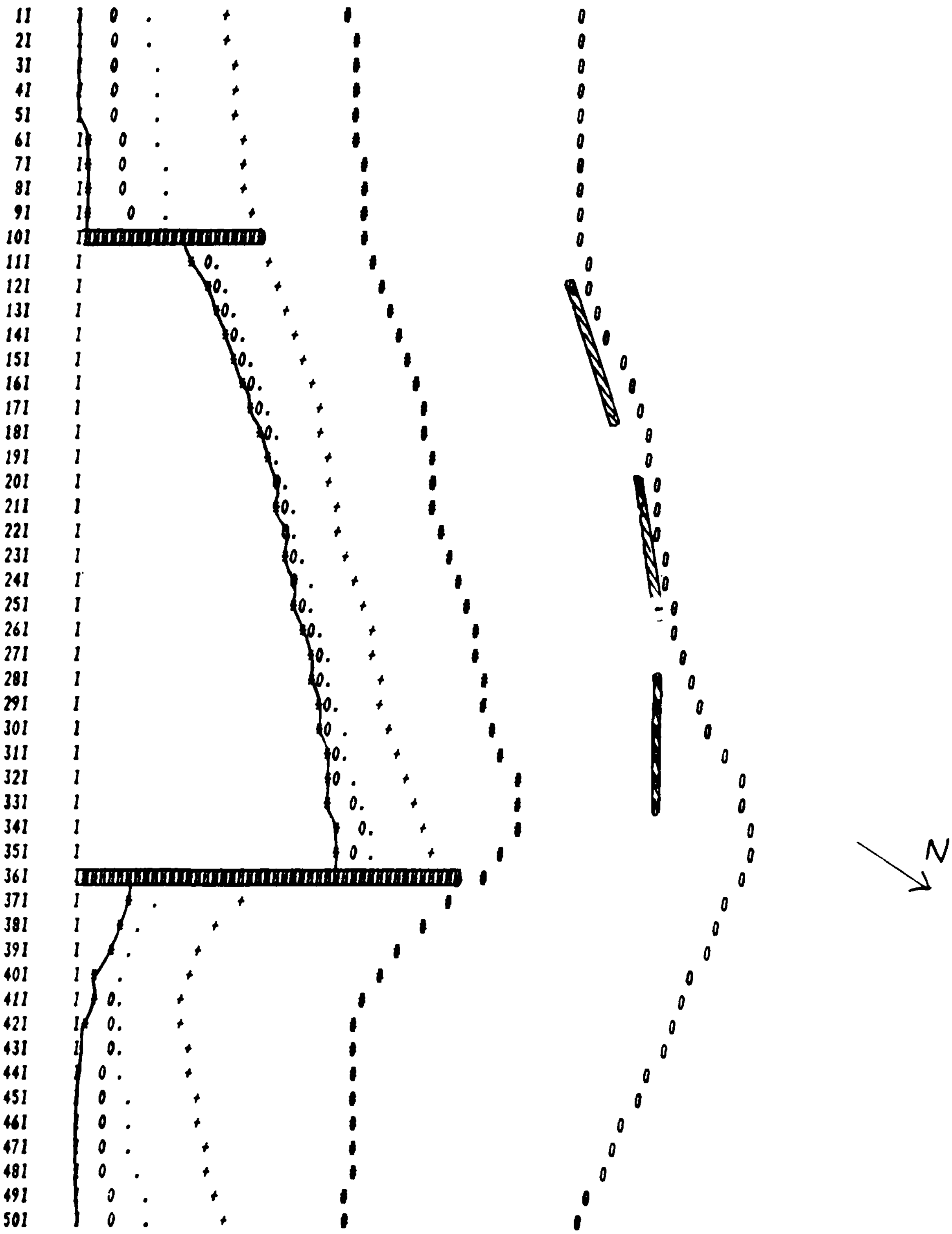

Figure 29. Three breakwater segments, two groins,
BRF = 0.5, t = 360 days

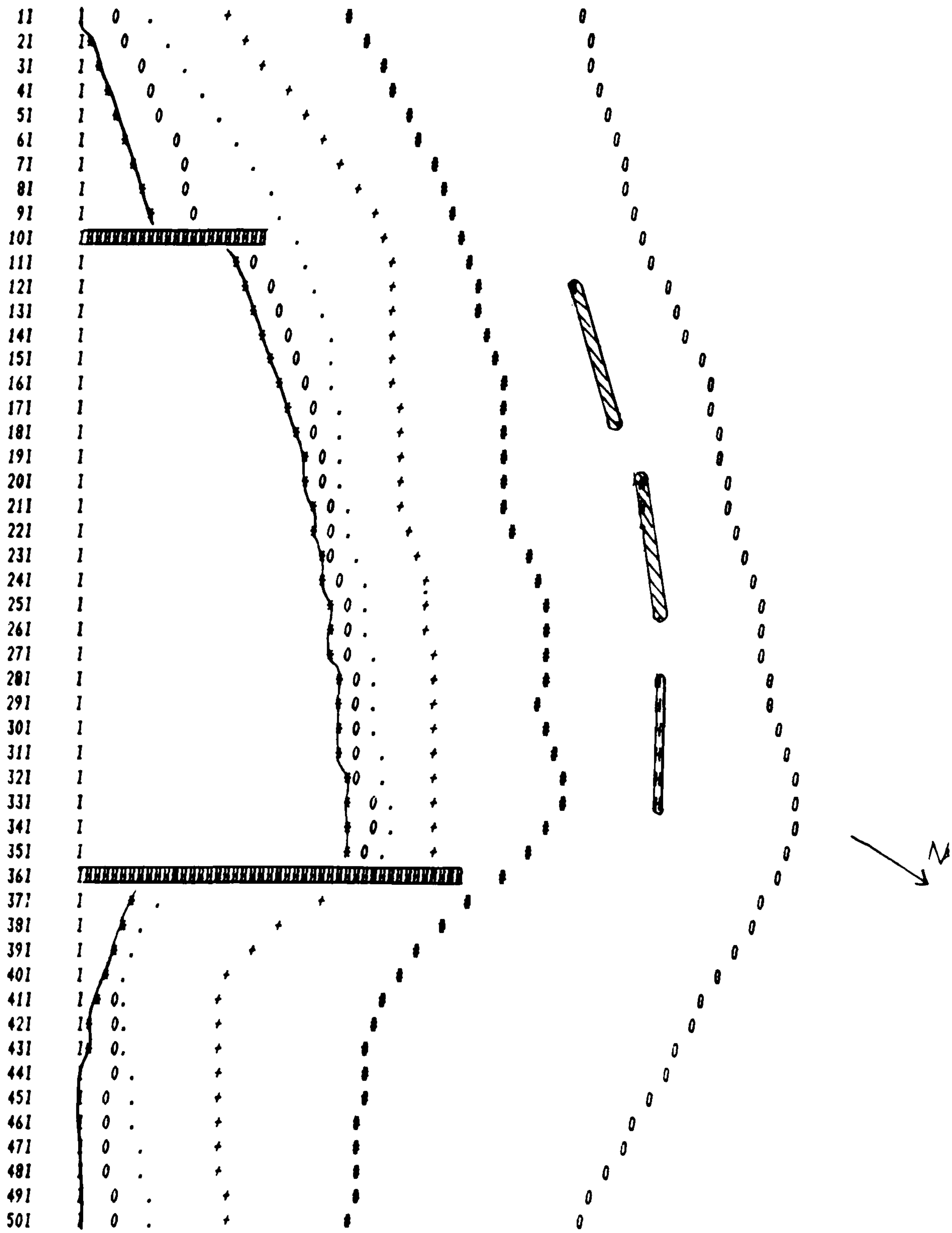

Figure 30. Three breakwater segments, two groins, BRF = 0.5, transport allowed across west groin, t = 360 days

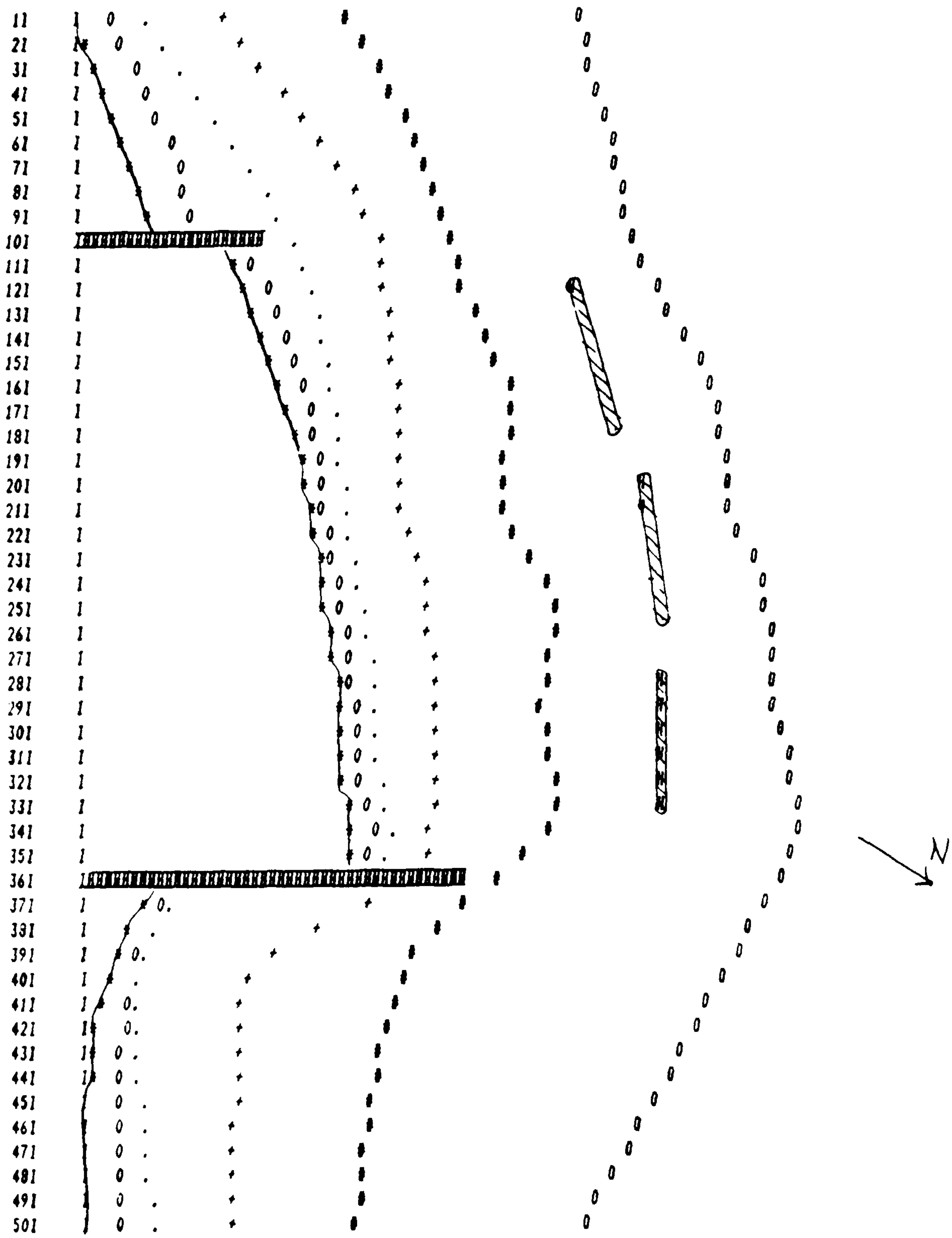

Figure 31. Three breakwater segments, two groins, BRF = 0.5, transport allowed across west groin, t = 300 days

PART VI: CONCLUSIONS

42. The N-line model presented in this report is versatile, easy to use, and capable of producing dependable results when used for appropriate applications. The documentation presented in this report is intended to cover only the breakwater subroutine. Since conceptual modifications were not made to the original model, the original documentation presented in Perlin and Dean (1983) should be obtained by any potential user of the model.

43. The N-line model is useful in showing qualitative trends for a complex case such as Lakeview Park. Some of the drawbacks of the program when modeling Lakeview Park, such as the inability to reach an equilibrium shoreline and the low sinuosity of the shoreline when influenced by breakwater segments, could possibly be successfully modeled by modifying the different input parameters (such as the ADEAN parameter, the initial shoreline location, and/or the model code). Perhaps then a quantitative verification of the model could be made. However, in this case, the model would have then been tailored to produce a previously known result.

44. A project cannot be successfully modeled without experimenting with different time-steps, space-steps, contour depths, shoreline locations, and structure configurations. A wave climate representative of the area being modeled is also very important. Finally, the response of the model to a particular setup must be interpreted with engineering judgment.

REFERENCES

Bottin, R. R. 1982. "Lakeview Park Beach Erosion Study, Ohio," unpublished Letter Report, 30 September, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Moore, B. 1982. "Beach Profile Evolution in Response to Changes in Water Level and Wave Height," M.S. Thesis, University of Delaware, Newark, Del.

Perlin, M., and Dean, R. G. 1983 (May). "A Numerical Model to Simulate Sediment Transport in the Vicinity of Coastal Structures," MR 83-10, Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Pope, J., and Rowen, D. D. 1983. "Breakwaters for Beach Protection at Lorain, OH," Coastal Structures '83, American Society of Civil Engineers, New York.

Saville, T., Jr. 1953. "Wave and Lake Level Statistics for Lake Erie," Technical Memorandum No. 37, Beach Erosion Board.

APPENDIX A: EXAMPLES OF INPUT AND OUTPUT DATA

EXAMPLE 1 - INPUT

```
      50         8
            10.000
   1.000   2.000   3.000   4.000   5.000   7.000   9.000  12.000  18.000  32.808
    .000    .000    .000    .000    .000    .000    .000    .000    .000    .000
      30
             3.000     .0500     .220
 1
25    300.000
    .1486
  100.000 21600.000
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
   0
   1         3.0   7.0  60.0    0
   2         3.0   7.0  60.0    0
   3         3.0   7.0  60.0    0
   4         3.0   7.0  60.0    0
   5         3.0   7.0  60.0    0
   6         3.0   7.0  60.0    0
   7         3.0   7.0  60.0    0
   8         3.0   7.0  60.0    0
   9         3.0   7.0  60.0    0
  10         3.0   7.0  60.0    0
  11         3.0   7.0  60.0    0
  12         3.0   7.0  60.0    0
  13         3.0   7.0  60.0    0
  14         3.0   7.0  60.0    0
  15         3.0   7.0  60.0    0
  16         3.0   7.0  60.0    0
  17         3.0   7.0  60.0    0
  18         3.0   7.0  60.0    0
  19         3.0   7.0  60.0    0
  20         3.0   7.0  60.0    0
  21         3.0   7.0  60.0    0
  22         3.0   7.0  60.0    0
  23         3.0   7.0  60.0    0
  24         3.0   7.0  60.0    0
  25         3.0   7.0  60.0    0
  26         3.0   7.0  60.0    0
  27         3.0   7.0  60.0    0
  28         3.0   7.0  60.0    0
  29         3.0   7.0  60.0    0
  30         3.0   7.0  60.0    0
  31        99.0  99.0  99.0    0
```

EXAMPLE 1 - SPOOL: NONE

EXAMPLE 1 - OUTPUT

```
******************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=      32.808
******************************************************
  THE HEIGHT OF THE BERM, BERM=       3.000
  THE SLOPE OF THE BEACH FACE, SFACE=        .0500
  THE SEDIMENT DIAMETER, DIAM=        .220
******************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=     300.000
  THE NUMBER    1 GROIN IS LOCATED AT GRID   25
******************************************************
  THE VALUE OF ADEAN=       .1486  IN THE EQ. H=AY**2/3
******************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    100.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
******************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
******************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00   32.07   69.01  114.31  166.64  256.57  395.01  593.96 1014.17 2235.24
     .00   32.07   69.01  114.31  166.64  256.57  395.01  593.96 1014.17 2235.24
******************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
    1.00    2.00    3.00    4.00    5.00    7.00    9.00   12.00   18.00   32.81
******************************************************
    1          3.0   7.0  60.0    0
    2          3.0   7.0  60.0    0
    3          3.0   7.0  60.0    0
    4          3.0   7.0  60.0    0
    5          3.0   7.0  60.0    0
    6          3.0   7.0  60.0    0
    7          3.0   7.0  60.0    0
    8          3.0   7.0  60.0    0
    9          3.0   7.0  60.0    0
   10          3.0   7.0  60.0    0
   11          3.0   7.0  60.0    0
   12          3.0   7.0  60.0    0
   13          3.0   7.0  60.0    0
   14          3.0   7.0  60.0    0
   15          3.0   7.0  60.0    0
   16          3.0   7.0  60.0    0
   17          3.0   7.0  60.0    0
   18          3.0   7.0  60.0    0
   19          3.0   7.0  60.0    0
   20          3.0   7.0  60.0    0
   21          3.0   7.0  60.0    0
   22          3.0   7.0  60.0    0
   23          3.0   7.0  60.0    0
   24          3.0   7.0  60.0    0
   25          3.0   7.0  60.0    0
```

26	3.0	7.0	60.0	0
27	3.0	7.0	60.0	0
28	3.0	7.0	60.0	0
29	3.0	7.0	60.0	0
30	3.0	7.0	60.0	0

THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV= 30

LONGSHORE STATION 1									
Y	.000	32.071	69.005	114.307	166.644	256.566	395.009	593.958	1014.165
QX	.005	.113	.527	.725	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 2									
Y	.003	32.129	69.330	115.697	166.584	256.565	395.009	593.958	1014.165
QX	.005	.113	.527	.725	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 3									
Y	.010	32.200	69.552	116.999	166.494	256.562	395.009	593.958	1014.165
QX	.005	.114	.525	.722	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 4									
Y	.021	32.280	69.746	118.314	166.354	256.554	395.009	593.958	1014.165
QX	.005	.113	.524	.721	.232	.008	.000	.000	.000
QY	.000	.000	-.001	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 5									
Y	.038	32.380	70.013	119.772	166.188	256.543	395.009	593.958	1014.165
QX	.005	.113	.523	.718	.232	.008	.000	.000	.000
QY	.000	.000	-.001	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 6									
Y	.068	32.529	70.405	121.447	166.025	25[illegible].532	395.009	593.958	1014.165
QX	.005	.113	.522	.715	.232	.008	.000	.000	.000
QY	.000	.000	-.001	.000	.000	[illegible]	.000	.000	.000
LONGSHORE STATION 7									
Y	.116	32.757	70.966	123.394	165.872	256.513	395.009	593.958	1014.165
QX	.005	.113	.520	.710	.232	.008	.000	.000	.000
QY	.000	-.001	-.001	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 8									
Y	.195	33.092	71.748	125.671	165.767	256.5[illegible]	395.009	593.958	1014.165
QX	.005	.113	.517	.705	.233	.008	.000	.000	.000
QY	.000	-.001	-.002	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 9									
Y	.315	33.573	72.818	128.340	165.731	256.4[illegible]	395.009	593.958	1014.165
QX	.005	.113	.514	.699	.234	[illegible]	[illegible]	[illegible]	[illegible]
QY	.000	-.001	-.002	-.001	.000	[illegible]	.000	.000	.000
LONGSHORE STATION 10									
Y	.497	34.250	74.261	131.464	165.826	256.454	395.009	593.958	1014.165
QX	.005	.113	.510	.692	.234	.009	.000	.000	.000
QY	-.001	-.002	-.003	-.001	.000	.000	.000	.000	.000
LONGSHORE STATION 11									
Y	.765	35.188	76.150	135.113	166.141	256.411	395.009	593.958	1014.165
QX	.005	.113	.505	.685	.234	.009	.000	.000	.000
QY	-.001	-.002	-.004	-.001	.000	.000	.000	.000	.000
LONGSHORE STATION 12									
Y	1.155	36.470	78.705	139.363	166.797	256.362	395.009	593.958	1014.165
QX	.005	.112	.498	.676	.234	.009	.000	.000	.000
QY	-.001	-.003	-.005	-.001	.000	.000	.000	.000	.000

LONGSHORE STATION 13									
Y	1.715	38.201	81.992	144.295	167.951	256.305	395.008	593.958	1014.165
QX	.005	.112	.489	.666	.234	.009	.000	.000	.000
QY	-.001	-.004	-.007	-.001	.001	.000	.000	.000	.000
LONGSHORE STATION 14									
Y	2.507	40.508	86.225	149.993	169.796	256.223	395.008	593.958	1014.165
QX	.005	.111	.478	.656	.233	.009	.000	.000	.000
QY	-.002	-.006	-.009	-.001	.001	.000	.000	.000	.000
LONGSHORE STATION 15									
Y	3.614	43.545	91.616	156.543	172.556	256.125	395.008	593.958	1014.165
QX	.005	.109	.465	.644	.232	.009	.000	.000	.000
QY	-.002	-.008	-.011	-.001	.001	.000	.000	.000	.000
LONGSHORE STATION 16									
Y	5.137	47.488	98.409	164.032	176.469	256.030	395.008	593.958	1014.165
QX	.006	.108	.448	.632	.229	.010	.000	.000	.000
QY	-.003	-.010	-.014	-.001	.001	.000	.000	.000	.000
LONGSHORE STATION 17									
Y	7.193	52.541	106.880	172.562	181.785	255.992	395.008	593.958	1014.165
QX	.006	.106	.428	.619	.226	.010	.000	.000	.000
QY	-.004	-.013	-.017	-.001	.001	.000	.000	.000	.000
LONGSHORE STATION 18									
Y	9.909	58.950	117.433	182.161	188.556	256.119	395.008	593.958	1014.165
QX	.006	.103	.404	.607	.223	.011	.000	.000	.000
QY	-.005	-.017	-.021	-.001	.001	.000	.000	.000	.000
LONGSHORE STATION 19									
Y	13.397	66.888	130.254	193.314	197.600	256.787	395.011	593.958	1014.165
QX	.006	.101	.380	.587	.213	.011	.000	.000	.000
QY	-.006	-.021	-.026	-.018	.001	.000	.000	.000	.000
LONGSHORE STATION 20									
Y	17.727	76.474	145.228	206.779	209.343	[illegible]	395.015	593.958	1014.165
QX	.006	.097	.358	.569	.221	.015	.000	.000	.000
QY	-.007	-.026	-.032	-.016	.001	.000	.000	.000	.000
LONGSHORE STATION 21									
Y	22.898	87.925	162.495	222.303	224.925	261.579	395.022	593.958	1014.165
QX	.006	.094	.334	.539	.211	.015	.000	.000	[illegible]
QY	-.008	-.033	-.038	-.015	.001	.001	.000	.000	.000
LONGSHORE STATION 22									
Y	28.759	101.343	182.290	239.479	241.472	[illegible]	[illegible]	[illegible]	[illegible]
QX	.006	.090	.302	.511	.205	[illegible]	[illegible]	.000	[illegible]
QY	-.009	-.040	-.044	-.012	.001	[illegible]	[illegible]	[illegible]	[illegible]
LONGSHORE STATION 23									
Y	34.305	116.411	204.252	257.607	259.404	[illegible]	[illegible]	[illegible]	[illegible]
QX	[illegible]	[illegible]	.268	.504	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
QY	-.009	-.049	-.051	[illegible]	.001	[illegible]	[illegible]	.000	[illegible]
LONGSHORE STATION 24									
Y	40.605	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
QX	.006	[illegible]	[illegible]	.407	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
QY	[illegible]	-.061	-.059	-.005	.022	[illegible]	[illegible]	[illegible]	[illegible]
LONGSHORE STATION 25									
Y	44.259	[illegible]	251.641	266.914	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
QX	.007	.080	[illegible]	[illegible]	.285	[illegible]	[illegible]	[illegible]	[illegible]
QY	[illegible]	-.071	-.067	.001	.022	.001	.000	[illegible]	[illegible]
LONGSHORE STATION 26									
Y	-49.295	-46.269	-44.450	177.726	191.930	[illegible]	[illegible]	[illegible]	[illegible]
QX	.000	.000	.000	.000	.000	.009	.000	[illegible]	[illegible]

QY	.010	.014	.001	.000	.000	.000	.000	.00[illegible]	[illegible]
LONGSHORE STATION 27									
Y	-51.222	-48.249	-46.430	48.840	116.942	256.328	395.021	593.958	1014.165
QX	.017	.028	.000	.000	.000	.000	.000	.000	.000
QY	.009	.053	.019	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 28									
Y	-51.352	-48.415	-46.596	-35.806	75.695	254.699	395.013	593.958	1014.165
QX	.009	.114	.030	.000	.000	.000	.000	.000	.000
QY	.010	.056	.076	.001	-.001	-.001	.000	.000	.000
LONGSHORE STATION 29									
Y	-47.975	-44.934	-43.251	-41.432	68.367	253.722	395.008	593.958	1014.165
QX	.003	.070	.269	.699	.180	.004	.000	.000	.000
QY	.010	.064	.089	.033	-.001	-.001	.000	.000	.000
LONGSHORE STATION 30									
Y	-37.328	-34.371	-32.552	-27.336	79.830	253.510	395.005	593.958	1014.165
QX	.002	.064	.307	.383	.164	.008	.000	.000	.000
QY	.010	.037	.044	.002	-.001	-.001	.000	.000	.000
LONGSHORE STATION 31									
Y	-27.621	-24.580	-20.612	-9.508	93.796	254.012	395.005	593.958	1014.165
QX	.003	.077	.375	.426	.178	.010	.000	.000	.000
QY	.009	.029	.033	.034	-.001	-.001	.000	.000	.000
LONGSHORE STATION 32									
Y	-20.452	-14.400	-6.957	8.750	109.649	255.101	395.007	593.958	1014.165
QX	.004	.086	.388	.480	.204	.016	.000	.000	.000
QY	.008	.026	.029	.030	-.001	-.001	.000	.000	.000
LONGSHORE STATION 33									
Y	-15.024	-4.827	6.165	25.718	125.137	256.289	395.008	593.958	1014.165
QX	.004	.097	.403	.519	.210	.016	.000	.000	.000
QY	.007	.022	.026	.026	-.001	.000	.000	.000	.000
LONGSHORE STATION 34									
Y	[illegible]	[illegible].541	[illegible]	[illegible]	138.389	[illegible].222	395.01[illegible]	593.958	1014.165
QX	.005	.102	.415	.55[illegible]	.220	[illegible]16	.000	.000	.000
QY	.006	.017	.022	[illegible]	-.001	[illegible]	.000	.000	.000
LONGSHORE STATION 35									
Y	-7.722	[illegible].472	[illegible]	[illegible]	150.14[illegible]	257.71[illegible]	395.[illegible]	593.958	1014.165
QX	.006	.105	.424	[illegible]	[illegible]	[illegible]	[illegible]	.000	.000
QY	.004	.014	[illegible]	[illegible]	-.001	[illegible]	[illegible]	.000	[illegible]
LONGSHORE STATION 36									
Y	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	395.011	[illegible]	[illegible].165
[illegible]	[illegible]	[illegible]	.416	[illegible]	[illegible]	[illegible]	[illegible]	.000	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LONGSHORE STATION [illegible]									
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.000	[illegible]
LONGSHORE STATION [illegible]									
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].165
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
LONGSHORE STATION [illegible]									
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].958	1014.165
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.000
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	.000	[illegible]
LONGSHORE STATION [illegible]									
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible].958	1014.165

```
QX        .005      .113      .492      .668      .238      .009      .000      .000      .000
QY        .001      .003      .005      .001     -.001      .000      .000      .000      .000
LONGSHORE STATION    41
Y        -.674    29.164    62.125    94.265   168.750   256.801   395.009   593.9581014.165
QX        .005      .113      .500      .677      .238      .009      .000      .000      .000
QY        .001      .002      .004      .001      .000      .000      .000      .000      .000
LONGSHORE STATION    42
Y        -.423    30.062    63.998    97.904   168.711   256.728   395.009   593.9581014.165
QX        .005      .113      .506      .686      .237      .009      .000      .000      .000
QY        .001      .002      .003      .001      .000      .000      .000      .000      .000
LONGSHORE STATION    43
Y        -.259    30.696    65.384   101.000   168.487   256.678   395.009   593.9581014.165
QX        .005      .113      .511      .693      .236      .009      .000      .000      .000
QY        .000      .001      .002      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    44
Y        -.155    31.140    66.402   103.645   168.188   256.645   395.009   593.9581014.165
QX        .005      .113      .515      .700      .235      .008      .000      .000      .000
QY        .000      .001      .002      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    45
Y        -.089    31.446    67.142   105.921   167.878   256.621   395.009   593.9581014.165
QX        .005      .114      .518      .705      .234      .008      .000      .000      .000
QY        .000      .000      .001      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    46
Y        -.050    31.653    67.673   107.896   167.589   256.605   395.009   593.9581014.165
QX        .005      .114      .520      .710      .234      .008      .000      .000      .000
QY        .000      .000      .001      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    47
Y        -.027    31.793    68.046   109.634   167.330   256.593   395.009   593.9581014.165
QX        .005      .114      .522      .714      .233      .008      .000      .000      .000
QY        .000      .000      .001      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    48
Y        -.012    31.899    68.310   111.194   167.093   256.583   395.009   593.9581014.165
QX        .005      .114      .523      .717      .233      .008      .000      .000      .000
QY        .000      .000      .000      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    49
Y        -.004    31.992    68.598   112.708   166.861   256.573   395.009   593.9581014.165
QX        .005      .114      .524      .718      .232      .008      .000      .000      .000
QY        .000      .000      .000      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    50
Y         .000    32.071    69.005   114.307   166.644   256.566   395.009   593.9581014.165
QX        .005      .113      .526      .721      .232      .008      .000      .000      .000
QY        .000      .000      .000      .000      .000      .000      .000      .000      .000
```

```
 1I     I   0   .     +      *          0
 2I     I   0   .     +      *          0
 3I     I   0   .     +      *          0
 4I     I   0   .      +     *          0
 5I     I   0    .     +     *          0
 6I     I   0    .     +     *          0
 7I     I   0    .     +    *           0
 8I     I   0    .     +    *           0
 9I     I   0    .      +   *           0
10I     I   0    .      +   *           0
11I     I   0    .       +   *          0
12I     I   0     .      +   *          0
13I     I    0    .       +  *          0
14I     I    0     .      +  *          0
15I     I    0     .       + *          0
16I     I     0     .       + *         0
17I     I*    0      .       +*         0
18I     I*     0      .        *        0
19I     I*      0       .       *       0
20I     I *      0        .       *     0
21I     I  *       0        .       *   0
22I     I  *        0          .      *  0
23I     I   *         0          .      * 0
24I     I    *          0           .     +0
25I     IHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
26I.    I                     + *       0
27I.    I     +       *                 0
28I+    I        *                      0
29I+    I       *                      0
30I0+   I         *                    0
31I *. +I          *                    0
32I  *0.I+           *                  0
33I   *0I.  +           *                0
34I   * I .  +           *              0
35I    *I0 .  +            *            0
36I    *I 0  .  +          *            0
37I    *I 0   .  +          *           0
38I    *I  0  .   +         *           0
39I     I  0   .  +          *          0
40I     I  0   .   +         *          0
41I     I  0    .   +        *          0
42I     I   0   .   +        *          0
43I     I   0   .   +        *          0
44I     I   0   .    +       *          0
45I     I   0   .    +       *          0
46I     I   0   .    +       *          0
47I     I   0   .    +       *          0
48I     I   0   .     +      *          0
49I     I   0   .     +      *          0
50I     I   0   .     +      *          0
 31       99.0  99.0  99.0    0
```

EXAMPLE 2 - INPUT

```
     50           8
           10.000
  1.000    2.000    3.000    4.000    5.000    7.000   10.000   15.000   25.000   32.808
   .000     .000     .000     .000     .000     .000     .000     .000     .000     .000
     30
            3.000      .0500      .220
 3
12    300.000
25    300.000
38    300.000
    .0899
  100.000 21600.000
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
   0
   1         3.0    7.0   60.0     0
   2         3.0    7.0   60.0     0
   3         3.0    7.0   60.0     0
   4         3.0    7.0   60.0     0
   5         3.0    7.0   60.0     0
   6         3.0    7.0   60.0     0
   7         3.0    7.0   60.0     0
   8         3.0    7.0   60.0     0
   9         3.0    7.0   60.0     0
  10         3.0    7.0   60.0     0
  11         3.0    7.0   60.0     0
  12         3.0    7.0   60.0     0
  13         3.0    7.0   60.0     0
  14         3.0    7.0   60.0     0
  15         3.0    7.0   60.0     0
  16         3.0    7.0   60.0     0
  17         3.0    7.0   60.0     0
  18         3.0    7.0   60.0     0
  19         3.0    7.0   60.0     0
  20         3.0    7.0   60.0     0
  21         3.0    7.0   60.0     0
  22         3.0    7.0   60.0     0
  23         3.0    7.0   60.0     0
  24         3.0    7.0   60.0     0
  25         3.0    7.0   60.0     0
  26         3.0    7.0   60.0     0
  27         3.0    7.0   60.0     0
  28         3.0    7.0   60.0     0
  29         3.0    7.0   60.0     0
  30         3.0    7.0   60.0     0
  31        99.0   99.0   99.0     0
```

EXAMPLE 2 - SPOOL: NONE

EXAMPLE 2 - OUTPUT

```
*******************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=     32.808
*******************************************************
  THE HEIGHT OF THE BERM, BERM=       3.000
  THE SLOPE OF THE BEACH FACE, SFACE=       .0500
  THE SEDIMENT DIAMETER, DIAM=       .220
*******************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=    300.000
  THE LENGTH OF THE STRUCTURE, SJETTY=    300.000
  THE LENGTH OF THE STRUCTURE, SJETTY=    300.000
  THE NUMBER     1 GROIN IS LOCATED AT GRID   12
  THE NUMBER     2 GROIN IS LOCATED AT GRID   25
  THE NUMBER     3 GROIN IS LOCATED AT GRID   38
*******************************************************
  THE VALUE OF ADEAN=       .0899  IN THE EQ. H=AY**2/3
*******************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    100.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
*******************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
*******************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00    68.15  146.65  242.92  354.14  545.24  919.37 1639.55 3318.22 5764.97
     .00    68.15  146.65  242.92  354.14  545.24  919.37 1639.55 3318.22 5764.97
*******************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
    1.00    2.00    3.00    4.00    5.00    7.00   10.00   15.00   25.00   32.81
*******************************************************
     1         3.0    7.0  60.0     0
     2         3.0    7.0  60.0     0
     3         3.0    7.0  60.0     0
     4         3.0    7.0  60.0     0
     5         3.0    7.0  60.0     0
     6         3.0    7.0  60.0     0
     7         3.0    7.0  60.0     0
     8         3.0    7.0  60.0     0
     9         3.0    7.0  60.0     0
    10         3.0    7.0  60.0     0
    11         3.0    7.0  60.0     0
    12         3.0    7.0  60.0     0
    13         3.0    7.0  60.0     0
    14         3.0    7.0  60.0     0
    15         3.0    7.0  60.0     0
    16         3.0    7.0  60.0     0
    17         3.0    7.0  60.0     0
    18         3.0    7.0  60.0     0
    19         3.0    7.0  60.0     0
    20         3.0    7.0  60.0     0
    21         3.0    7.0  60.0     0
```

```
   22          3.0    7.0   60.0      0
   23          3.0    7.0   60.0      0
   24          3.0    7.0   60.0      0
   25          3.0    7.0   60.0      0
   26          3.0    7.0   60.0      0
   27          3.0    7.0   60.0      0
   28          3.0    7.0   60.0      0
   29          3.0    7.0   60.0      0
   30          3.0    7.0   60.0      0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=     30

LONGSHORE STATION     1
Y           .000  68.155 146.646 242.920 354.143 545.240 919.3671639.5533318.222
QX          .004    .106    .472    .659    .262    .012    .000    .000    .000
QY          .000    .000    .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION     2
Y          1.656  72.780 155.034 252.783 357.283 545.350 919.3671639.5533318.222
QX          .004    .106    .472    .659    .262    .012    .000    .000    .000
QY         -.001   -.003   -.004   -.001    .000    .000    .000    .000    .000
LONGSHORE STATION     3
Y          3.376  77.162 162.277 261.592 360.279 545.417 919.3671639.5533318.222
QX          .005    .104    .455    .644    .260    .012    .000    .000    .000
QY         -.001   -.006   -.007    .000    .001    .000    .000    .000    .000
LONGSHORE STATION     4
Y          5.254  81.491 169.080 269.782 363.081 545.410 919.3671639.5533318.222
QX          .005    .102    .448    .640    .255    .011    .000    .000    .000
QY         -.002   -.008   -.009    .000    .001    .000    .000    .000    .000
LONGSHORE STATION     5
Y          7.434  86.192 176.448 278.114 366.225 545.374 919.3671639.5533318.222
QX          .005    .100    .438    .635    .251    .011    .000    .000    .000
QY         -.003   -.011   -.012   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION     6
Y         10.097  91.704 184.892 286.967 370.225 545.344 919.3671639.5533318.222
QX          .005    .098    .423    .627    .249    .011    .000    .000    .000
QY         -.004   -.013   -.015   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION     7
Y         13.427  98.553 195.077 297.063 374.767 545.255 919.3671639.5533318.222
QX          .005    .096    .406    .616    .243    .011    .000    .000    .000
QY         -.005   -.017   -.018   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION     8
Y         17.563 107.361 207.982 309.919 379.891 545.096 919.3671639.5533318.222
QX          .005    .095    .388    .610    .232    .010    .000    .000    .000
QY         -.005   -.022   -.022   -.001    .002    .001    .000    .000    .000
LONGSHORE STATION     9
Y         22.529 119.749 224.597 326.422 386.258 544.995 919.3681639.5533318.222
QX          .005    .093    .368    .616    .229    .011    .000    .000    .000
QY         -.006   -.028   -.027   -.001    .002    .001    .000    .000    .000
LONGSHORE STATION    10
Y         28.049 132.303 244.774 347.258 395.998 545.513 919.3701639.5533318.222
QX          .005    .091    .349    .593    .218    .012    .000    .000    .000
QY         -.007   -.037   -.033   -.006    .003    .001    .000    .000    .000
LONGSHORE STATION    11
Y         33.438 150.595 269.309 369.740 410.457 547.117 919.3721639.5533318.222
QX          .005    .081    .301    .632    .241    .121    .000    .000    .000
QY         -.007   -.049   -.040   -.004    .003    .001    .000    .000    .000
```

LONGSHORE STATION 12									
Y	37.105	166.364	291.059	388.628	427.770	548.818	919.373	1639.553	3318.222
QX	.006	.091	.353	.524	.221	.022	.000	.000	.000
QY	-.008	-.061	-.046	-.001	.003	.001	.000	.000	.000
LONGSHORE STATION 13									
Y	-24.708	15.548	86.456	349.719	423.819	548.919	919.373	1639.553	3318.222
QX	.000	.000	.162	1.076	.286	.012	.000	.000	.000
QY	.004	.028	.000	-.006	.001	.001	.000	.000	.000
LONGSHORE STATION 14									
Y	-23.991	15.392	72.875	246.700	380.615	547.224	919.370	1639.553	3318.222
QX	.002	.031	.057	.003	.000	.000	.000	.000	.000
QY	.004	.029	.022	-.004	-.001	.000	.000	.000	.000
LONGSHORE STATION 15									
Y	-22.565	15.505	66.466	134.606	331.924	544.968	919.366	1639.553	3318.222
QX	.001	.028	.213	.598	.041	.000	.000	.000	.000
QY	.004	.030	.028	-.001	-.001	.000	.000	.000	.000
LONGSHORE STATION 16									
Y	-20.043	18.437	70.503	177.230	302.357	542.853	919.361	1639.553	3318.222
QX	.002	.043	.230	.467	.102	.001	.000	.000	.000
QY	.004	.030	.027	-.001	.000	-.001	.000	.000	.000
LONGSHORE STATION 17									
Y	-16.348	26.500	81.464	173.219	285.548	540.893	919.358	1639.553	3318.222
QX	.003	.063	.236	.435	.104	.001	.000	.000	.000
QY	.003	.026	.024	.000	.000	-.001	.000	.000	.000
LONGSHORE STATION 18									
Y	-10.675	39.438	100.262	192.637	286.281	540.175	919.357	1639.553	3318.222
QX	.005	.084	.294	.484	.153	.003	.000	.000	.000
QY	.002	.018	.019	.004	.001	-.001	.000	.000	.000
LONGSHORE STATION 19									
Y	-4.340	55.032	124.160	215.565	305.461	541.537	919.359	1639.553	3318.222
QX	.005	.091	.324	.548	.264	.024	.000	.000	.000
QY	.001	.009	.009	.005	.001	-.001	.000	.000	.000
LONGSHORE STATION 20									
Y	2.519	71.143	148.686	240.136	329.887	543.600	919.363	1639.553	3318.222
QX	.005	.093	.319	.511	.233	.022	.000	.000	.000
QY	.000	-.001	.001	.005	.001	.000	.000	.000	.000
LONGSHORE STATION 21									
Y	9.214	87.018	172.311	263.303	352.628	545.152	919.367	1639.553	3318.222
QX	.005	.139	.308	.512	.247	.022	.000	.000	.000
QY	-.002	-.009	-.007	.005	.001	.000	.000	.000	.000
LONGSHORE STATION 22									
Y	16.204	103.272	196.441	286.899	373.603	546.219	919.371	1639.553	3318.222
QX	.005	.137	.297	.511	.242	.021	.000	.000	.000
QY	-.003	-.013	-.015	.008	.001	.000	.000	.000	.000
LONGSHORE STATION 23									
Y	23.839	121.845	222.471	313.273	392.820	547.273	919.373	1639.553	3318.222
QX	.005	.135	.287	.510	.218	.022	.000	.000	.000
QY	-.004	-.029	-.023	[illegible]	.001	.001	.000	.000	.000
LONGSHORE STATION 24									
Y	31.344	141.157	251.919	341.154	411.001	548.712	919.375	1639.553	3318.222
QX	.006	.079	.245	.577	.235	.025	.000	.000	.000
QY	-.015	-.143	.033	.008	.002	.001	.000	.000	.000
LONGSHORE STATION 25									
Y	34.575	159.146	279.713	364.465	419.119	549.361	919.376	1639.553	3318.222
QX	.006	.139	.311	.497	.224	.024	.000	.000	.000

```
QY       -.006   -.056    -.042     .012     .002     .001     .000     .000     .000
LONGSHORE STATION    26
Y      -25.599  11.801   67.545  330.446  424.795  549.448  919.3741639.553318.222
QX        .000    .000     .088    1.046     .288     .012     .000     .000     .000
QY        .005    .031     .001    -.006     .001     .001     .000     .000     .000
LONGSHORE STATION    27
Y      -24.763  12.010   59.613  234.257  380.862  547.419  919.3711639.553318.222
QX        .003    .037     .030     .002     .000     .000     .000     .000     .000
QY        .005    .032     .031    -.004    -.001     .000     .000     .000     .000
LONGSHORE STATION    28
Y      -23.172  12.716   57.587  177.587  332.281  545.033  919.3661639.553318.222
QX        .001    .031     .154     .607     .045     .000     .000     .000     .000
QY        .005    .032     .034    -.002    -.001     .000     .000     .000     .000
LONGSHORE STATION    29
Y      -20.480  16.268   63.861  172.436  303.300  542.891  919.3611639.553318.222
QX        .002    .044     .170     .446     .107     .001     .000     .000     .000
QY        .004    .031     .031    -.001    -.001    -.001     .000     .000     .000
LONGSHORE STATION    30
Y      -16.335  24.877   76.556  175.336  286.555  540.932  919.3581639.553318.222
QX        .004    .063     .211     .424     .105     .001     .000     .000     .000
QY        .004    .027     .027     .000     .000    -.001     .000     .000     .000
LONGSHORE STATION    31
Y      -10.842  38.297   96.727  189.353  286.948  540.218  919.3571639.553318.222
QX        .005    .084     .276     .473     .154     .003     .000     .000     .000
QY        .003    .019     .020     .004     .001    -.001     .000     .000     .000
LONGSHORE STATION    32
Y       -4.423  54.294  121.729  212.637  305.806  541.581  919.3591639.553318.222
QX        .005    .091     .311     .539     .266     .024     .000     .000     .000
QY        .001    .009     .011     .005     .001     .001     .000     .000     .000
LONGSHORE STATION    33
Y        2.488  70.697  147.074  237.407  329.913  541.934  919.3631639.553318.222
QX        .005    .093     .308     .505     .234     .022     .000     .000     .000
QY        .000    .000     .002     .006     .001     .000     .000     .000     .000
LONGSHORE STATION    34
Y        9.610  86.777  171.300  260.626  352.297  545.166  919.3671639.553318.222
QX        .005    .089     .298     .508     .248     .022     .000     .000     .000
QY       -.001   -.009    -.006     .007     .001     .001     .000     .000     .000
LONGSHORE STATION    35
Y       16.819 103.198  195.997  293.927  372.963  546.119  919.3701639.553318.222
QX        .005    .087     .297     .511     .243     .021     .000     .000     .000
QY       -.003   -.018    -.014     .008     .001     .000     .000     .000     .000
LONGSHORE STATION    36
Y       23.906 120.930  222.648  310.243  391.982  547.115  919.3721639.553318.222
QX        .005    .085     .276     .513     .238     .022     .000     .000     .000
QY       -.004   -.029    -.023     .009     .001     .001     .000     .000     .000
LONGSHORE STATION    37
Y       30.349 141.588  253.952  337.641  410.204  548.027  919.3751639.553318.222
QX        .006    .078     .230     .583     .215 [illegible]   .000     .000     .000
QY       -.005   -.043    -.034     .013     .002     .001     .000     .000     .000
LONGSHORE STATION    38
Y       34.579 159.473  281.630  360.057  428.410  549.300  919.3761639.553318.222
QX        .006    .092     .295     .497     .222     .024     .000     .000     .000
QY       -.006   -.057    -.044     .018     .002     .001     .000     .000     .000
LONGSHORE STATION    39
Y      -27.671   3.956   47.585  323.412  425.059  549.501  919.3751639.553318.222
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QX         .000     .000     .056    1.066     .283     .012     .000     .000     .000
QY         .006     .037     .001    -.006     .000     .001     .000     .000     .000
LONGSHORE STATION   40
Y       -26.828    5.847   43.269  221.134  382.807  547.727  919.3721639.5533318.222
QX         .003     .066     .035     .001     .000     .000     .000     .000     .000
QY         .006     .036     .041    -.004    -.001     .000     .000     .000     .000
LONGSHORE STATION   41
Y       -25.508    6.692   42.831  157.931  335.079  545.761  919.3681639.5533318.222
QX         .002     .030     .123     .571     .035     .000     .000     .000     .000
QY         .006     .036     .043    -.001    -.002     .000     .000     .000     .000
LONGSHORE STATION   42
Y       -23.608    8.959   48.609  149.889  308.920  544.299  919.3651639.5533318.222
QX         .002     .051     .186     .467     .087     .000     .000     .000     .000
QY         .006     .036     .039     .000    -.002    -.001     .000     .000     .000
LONGSHORE STATION   43
Y       -20.978   14.498   58.170  150.824  298.616  543.352  919.3621639.5533318.222
QX         .003     .066     .237     .465     .117     .001     .000     .000     .000
QY         .006     .033     .035     .000    -.001    -.001     .000     .000     .000
LONGSHORE STATION   44
Y       -17.827   21.892   69.821  157.075  297.735  542.894  919.3611639.5533318.222
QX         .004     .076     .283     .486     .141     .003     .000     .000     .000
QY         .006     .028     .031     .001    -.001    -.001     .000     .000     .000
LONGSHORE STATION   45
Y       -14.473   30.015   82.445  167.071  302.534  542.863  919.3611639.5533318.222
QX         .004     .085     .324     .498     .159     .004     .000     .000     .000
QY         .005     .024     .026     .001    -.001    -.001     .000     .000     .000
LONGSHORE STATION   46
Y       -11.178   38.179   95.317  179.720  311.133  541.199  919.3621639.5533318.222
QX         .005     .093     .358     .513     .179     .006     .000     .000     .000
QY         .004     .019     .021     .001    -.001    -.001     .000     .000     .000
LONGSHORE STATION   47
Y        -8.094   45.946  107.906  194.321  322.548  541.343  919.3641639.5533318.222
QX         .005     .098     .388     .529     .199     .008     .000     .000     .000
QY         .004     .014     .016     .001    -.001    -.001     .000     .000     .000
LONGSHORE STATION   48
Y        -5.249   53.266  119.949  209.648  334.622  544.542  919.3651639.5533318.222
QX         .005     .101     .409     .544     .220     .011     .000     .000     .000
QY         .002     .010     .012     .007    -.001     .000     .000     .000     .000
LONGSHORE STATION   49
Y        -2.578   60.564  132.496  225.519  345.066  544.330  919.3621639.5533318.222
QX         .005     .105     .417     .542     .220     .010     .000     .000     .000
QY         .001     .005     .006     .000     .000     .000     .000     .000     .000
LONGSHORE STATION   50
Y          .000   68.155  146.646  242.920  354.143  545.241  919.3471639.5533318.222
QX         .005     .108     .446     .574     .225     .011     .000     .000     .000
QY         .000     .000     .000     .000     .000     .000     .000     .000     .000
```

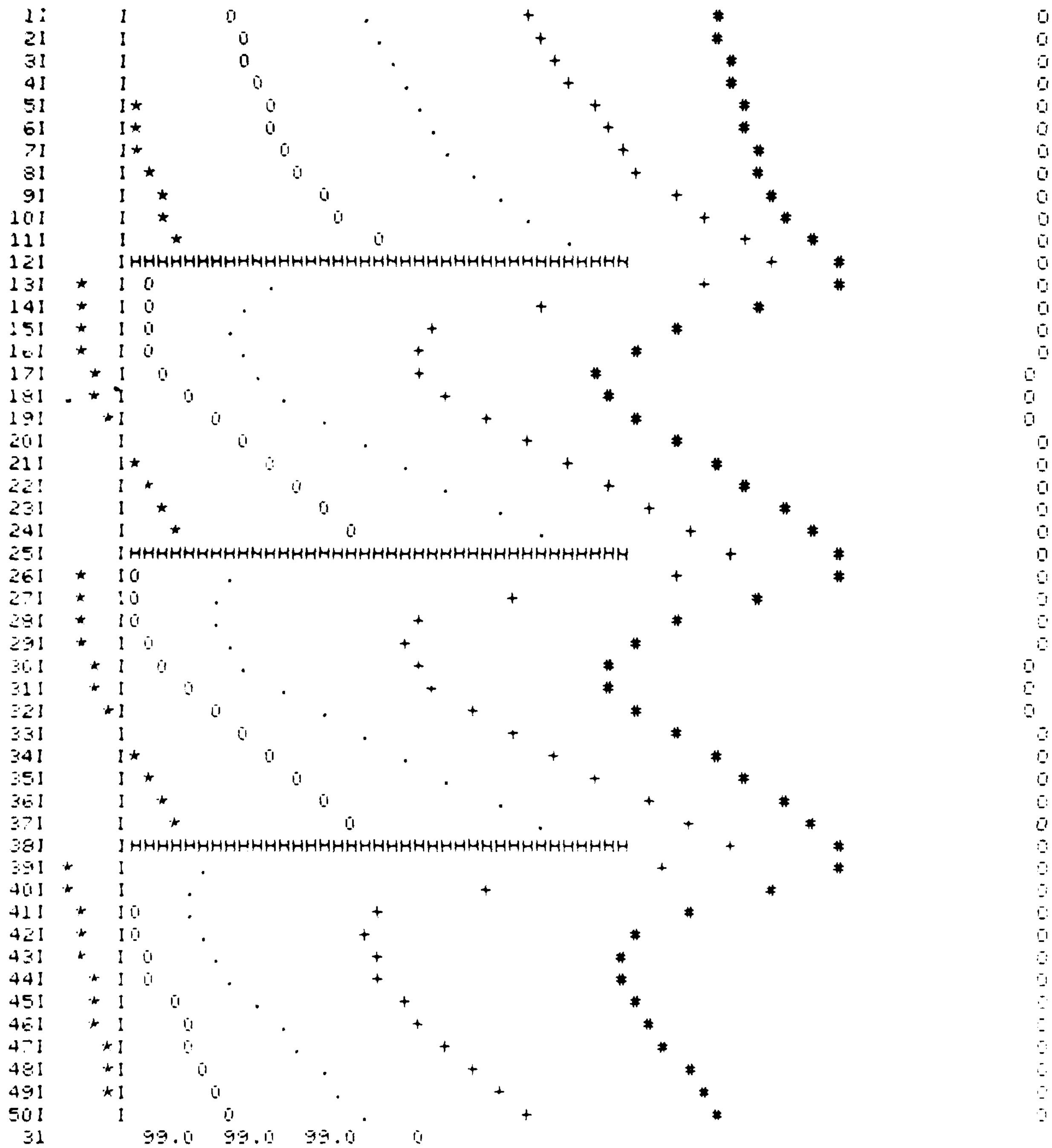

EXAMPLE 3 - INPUT

```
      50         8
            10.000
   1.000    2.000    3.000    5.000    7.000   11.000   14.000   17.000   25.000   32.808
    .000     .000     .000     .000     .000     .000     .000     .000     .000     .000
      30
             5.000      .0500      .220
1
3      .000
   .1500
 200.000 21600.000
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
   0
   1          3.0    7.0     .0     0
   2          3.0    7.0     .0     0
   3          3.0    7.0     .0     0
   4          3.0    7.0     .0     0
   5          3.0    7.0     .0     1
   6          3.0    7.0     .0     0
   7          3.0    7.0     .0     0
   8          3.0    7.0     .0     0
   9          3.0    7.0     .0     0
  10          3.0    7.0     .0     0
  11          3.0    7.0     .0     0
  12          3.0    7.0     .0     0
  13          3.0    7.0     .0     0
  14          3.0    7.0     .0     0
  15          3.0    7.0     .0     0
  16          3.0    7.0     .0     0
  17          3.0    7.0     .0     0
  18          3.0    7.0     .0     0
  19          3.0    7.0     .0     0
  20          3.0    7.0     .0     0
  21          3.0    7.0     .0     0
  22          3.0    7.0     .0     0
  23          3.0    7.0     .0     0
  24          3.0    7.0     .0     0
  25          3.0    7.0     .0     0
  26          3.0    7.0     .0     0
  27          3.0    7.0     .0     0
  28          3.0    7.0     .0     0
  29          3.0    7.0     .0     0
  30          3.0    7.0     .0     0
  31         99.0   99.0   99.0     0
```

EXAMPLE 3 - SPOOL

13	5	10.40
14	5	20.80
15	5	31.20
16	5	41.70
17	5	52.10
18	5	62.50
19	5	72.90
20	5	83.30
21	5	93.70
22	5	104.10
23	5	114.60
24	5	125.00
25	5	135.40
26	5	145.80
27	5	135.40
28	5	125.00
29	5	114.60
30	5	104.10
31	5	93.70
32	5	83.30
33	5	72.90
34	5	62.50
35	5	52.10
36	5	41.70
37	5	31.20
38	5	20.80
39	5	10.40
13	6	13.90
14	6	27.80
15	6	41.70
16	6	55.50
17	6	69.40
18	6	83.30
19	6	97.20
20	6	111.10
21	6	125.00
22	6	138.90
23	6	152.70
24	6	166.60
25	6	180.50
26	6	194.40
27	6	180.50
28	6	166.60
29	6	152.70
30	6	138.90
31	6	125.00
32	6	111.10
33	6	97.20
34	6	83.30
35	6	69.40
36	6	55.50
37	6	41.70
38	6	27.80
39	6	13.90
50	6	.00

EXAMPLE 3 – OUTPUT

```
*****************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=     32.808
*****************************************************
  THE HEIGHT OF THE BERM, BERM=       5.000
  THE SLOPE OF THE BEACH FACE, SFACE=       .0500
  THE SEDIMENT DIAMETER, DIAM=       .220
*****************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=        .000
  THE NUMBER    1 GROIN IS LOCATED AT GRID    3
*****************************************************
  THE VALUE OF ADEAN=       .1500  IN THE EQ. H=AY**2/3
*****************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    200.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
*****************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
*****************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.35
     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.35
*****************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
   1.00    2.00    3.00    5.00    7.00   11.00   14.00   17.00   25.00   32.81
*****************************************************
     1          3.0    7.0     .0    0
     2          3.0    7.0     .0    0
     3          3.0    7.0     .0    0
     4          3.0    7.0     .0    0
     5          3.0    7.0     .0    1
 DREDGED MATERIAL ADDED AT TIME      5
 CONTOURS AFTER MATERIAL ADDITION AT TIME     SARE:
    1      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    2      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    3      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    4      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    5      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    6      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    7      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    8      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
    9      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
   10      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
   11      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
   12      .000    31.623    68.041   137.706   252.982   464.758   760.728 1050.414
   13      .000    31.623    68.041   137.706   263.382   473.258   760.728 1050.414
   14      .000    31.623    68.041   137.706   273.782   481.558   760.728 1050.414
   15      .000    31.623    68.041   137.706   284.182   506.458   760.728 1050.414
   16      .000    31.623    68.041   137.706   294.682   520.258   760.728 1050.414
   17      .000    31.623    68.041   137.706   305.082   534.158   760.728 1050.414
   18      .000    31.623    68.041   137.706   315.482   548.058   760.728 1050.414
```

19	.000	31.623	68.041	137.706	325.882	561.958	760.726	1050.414
20	.000	31.623	68.041	137.706	336.282	575.858	760.726	1050.414
21	.000	31.623	68.041	137.706	346.682	589.758	760.726	1050.414
22	.000	31.623	68.041	137.706	357.082	603.658	760.726	1050.414
23	.000	31.623	68.041	137.706	367.582	617.458	760.726	1050.414
24	.000	31.623	68.041	137.706	377.982	631.358	760.726	1050.414
25	.000	31.623	68.041	137.706	388.382	645.258	760.726	1050.414
26	.000	31.623	68.041	137.706	398.782	659.158	760.726	1050.414
27	.000	31.623	68.041	137.706	388.382	645.258	760.726	1050.414
28	.000	31.623	68.041	137.706	377.982	631.358	760.726	1050.414
29	.000	31.623	68.041	137.706	367.582	617.458	760.726	1050.414
30	.000	31.623	68.041	137.706	357.082	603.658	760.726	1050.414
31	.000	31.623	68.041	137.706	346.682	589.758	760.726	1050.414
32	.000	31.623	68.041	137.706	336.282	575.858	760.726	1050.414
33	.000	31.623	68.041	137.706	325.882	561.958	760.726	1050.414
34	.000	31.623	68.041	137.706	315.482	548.058	760.726	1050.414
35	.000	31.623	68.041	137.706	305.082	534.158	760.726	1050.414
36	.000	31.623	68.041	137.706	294.682	520.258	760.726	1050.414
37	.000	31.623	68.041	137.706	284.182	506.458	760.726	1050.414
38	.000	31.623	68.041	137.706	273.782	492.558	760.726	1050.414
39	.000	31.623	68.041	137.706	263.382	478.658	760.726	1050.414
40	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
41	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
42	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
43	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
44	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
45	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
46	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
47	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
48	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
49	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
50	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414

6	3.0	7.0	.0	0
7	3.0	7.0	.0	0
8	3.0	7.0	.0	0
9	3.0	7.0	.0	0
10	3.0	7.0	.0	0
11	3.0	7.0	.0	0
12	3.0	7.0	.0	0
13	3.0	7.0	.0	0
14	3.0	7.0	.0	0
15	3.0	7.0	.0	0
16	3.0	7.0	.0	0
17	3.0	7.0	.0	0
18	3.0	7.0	.0	0
19	3.0	7.0	.0	0
20	3.0	7.0	.0	0
21	3.0	7.0	.0	0
22	3.0	7.0	.0	0
23	3.0	7.0	.0	0
24	3.0	7.0	.0	0
25	3.0	7.0	.0	0
26	3.0	7.0	.0	0
27	3.0	7.0	.0	0
28	3.0	7.0	.0	0

```
  29          3.0    7.0     .0     0
  30          3.0    7.0     .0     0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=     30

LONGSHORE STATION     1
Y          .000  31.623   68.041 137.706 252.982 464.758 760.7261050.4141656.502
QX         .000    .000     .000    .012   -.001    .000    .000    .000    .000
QY         .000    .000     .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION     2
Y         -.021  31.523   67.799 137.283 253.156 464.789 760.7261050.4141656.502
QX         .000    .000     .000    .012   -.001    .000    .000    .000    .000
QY         .000    .000     .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION     3
Y         -.044  31.417   67.559 136.861 253.377 464.847 760.7261050.4141656.502
QX         .000    .000     .001    .014   -.002    .000    .000    .000    .000
QY         .000    .000     .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION     4
Y         -.071  31.302   67.308 136.428 253.703 464.970 760.7261050.4141656.502
QX         .000    .000     .001    .015   -.002    .000    .000    .000    .000
QY         .000    .000     .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION     5
Y         -.102  31.175   67.036 135.975 254.202 465.225 760.7271050.4141656.502
QX         .000    .000     .001    .018   -.003    .000    .000    .000    .000
QY         .000    .001     .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION     6
Y         -.138  31.036   66.749 135.512 254.959 465.715 760.7271050.4141656.502
QX         .000    .000     .002    .021   -.005    .000    .000    .000    .000
QY         .000    .001     .001    .002    .000    .000    .000    .000    .000
LONGSHORE STATION     7
Y         -.177  30.891   66.458 135.060 256.075 466.534 760.7291050.4141656.502
QX         .000    .000     .002    .025   -.007    .000    .000    .000    .000
QY         .000    .001     .002    .002    .000    .000    .000    .000    .000
LONGSHORE STATION     8
Y         -.216  30.750   66.185 134.651 257.666 468.063 760.7311050.4141656.502
QX         .000    .000     .003    .030   -.010    .000    .000    .000    .000
QY         .000    .001     .002    .002    .000    .000    .000    .000    .000
LONGSHORE STATION     9
Y         -.252  30.629   65.958 134.327 259.855 470.165 760.7351050.4141656.502
QX         .000    .000     .003    .035   -.013    .000    .000    .000    .000
QY         .000    .001     .002    .003    .000    .000    .000    .000    .000
LONGSHORE STATION    10
Y         -.278  30.542   65.806 134.132 262.759 473.751 760.7411050.4141656.502
QX         .000    .000     .004    .040   -.017    .000    .000    .000    .000
QY         .000    .002     .002    .003   -.001    .000    .000    .000    .000
LONGSHORE STATION    11
Y         -.292  30.505   65.758 134.109 266.475 478.447 760.7491050.4141656.502
QX         .000    .000     .005    .046   -.021    .000    .000    .000    .000
QY         .000    .002     .002    .003   -.001    .000    .000    .000    .000
LONGSHORE STATION    12
Y         -.290  30.531   65.837 134.292 271.065 484.609 760.7581050.4141656.502
QX         .000    .000     .005    .051   -.026    .000    .000    .000    .000
QY         .000    .002     .002    .002   -.001    .000    .000    .000    .000
LONGSHORE STATION    13
Y         -.269  30.625   66.057 134.702 276.542 492.292 760.7721050.4141656.502
QX         .000    .001     .006    .056   -.030    .000    .000    .000    .000
```

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N-1
QY        .000      .001      .002      .002    -.001      .000      .000      .000      .000
LONGSHORE STATION    14
Y        -.229    30.791    66.421 135.343 282.868 501.438 760.7871050.4141656.502
QX        .000      .001      .007      .060    -.034      .000      .000      .000      .000
QY        .000      .001      .002      .002    -.002      .000      .000      .000      .000
LONGSHORE STATION    15
Y        -.171    31.024    66.924 136.206 289.952 511.883 760.8051050.4141656.502
QX        .000      .001      .007      .064    -.038      .000      .000      .000      .000
QY        .000      .001      .001      .001    -.002      .000      .000      .000      .000
LONGSHORE STATION    16
Y        -.098    31.317    67.551 137.267 297.654 523.385 760.8241050.4141656.502
QX        .000      .001      .008      .066    -.041      .000      .000      .000      .000
QY        .000      .000      .000      .000    -.002      .000      .000      .000      .000
LONGSHORE STATION    17
Y        -.013    31.663    68.286 138.496 305.796 535.654 760.8451050.4141656.502
QX        .000      .001      .008      .067    -.044      .000      .000      .000      .000
QY        .000      .000      .000     -.001    -.003      .000      .000      .000      .000
LONGSHORE STATION    18
Y         .084    32.050    69.104 139.855 314.168 548.378 760.8661050.4141656.502
QX        .000      .001      .008      .067    -.045      .000      .000      .000      .000
QY        .000     -.001     -.001     -.002    -.003      .000      .000      .000      .000
LONGSHORE STATION    19
Y         .189    32.467    69.981 141.298 322.534 561.226 760.8881050.4141656.502
QX        .000      .001      .008      .064    -.045      .000      .000      .000      .000
QY        .000     -.001     -.002     -.003    -.003      .000      .000      .000      .000
LONGSHORE STATION    20
Y         .299    32.901    70.884 142.774 330.633 573.339 760.9091050.4141656.502
QX        .000      .001      .007      .060    -.043      .000      .000      .000      .000
QY       -.001     -.002     -.003     -.004    -.004     -.001      .000      .000      .000
LONGSHORE STATION    21
Y         .411    33.334    71.776 144.220 338.188 585.907 760.9291050.4141656.502
QX        .000      .001      .007      .055    -.040      .000      .000      .000      .000
QY       -.001     -.003     -.004     -.006    -.004     -.001      .000      .000      .000
LONGSHORE STATION    22
Y         .519    33.742    72.611 145.561 344.910 596.661 760.9481050.4141656.502
QX        .000      .001      .006      .047    -.035      .000      .000      .000      .000
QY       -.001     -.003     -.005     -.007    -.004     -.001      .000      .000      .000
LONGSHORE STATION    23
Y         .615    34.100    73.336 146.719 350.512 605.382 760.9631050.4141656.502
QX        .000      .001      .005      .036    -.123      .000      .000      .000      .000
QY       -.001     -.004     -.006     -.007    -.004     -.001      .001      .000      .000
LONGSHORE STATION    24
Y         .681    34.361    73.899 147.611 354.731 612.343 760.9751050.4141656.502
QX        .000      .001      .004      .028    -.022      .000      .000      .000      .000
QY       -.001     -.004     -.008     -.008    -.005     -.001      .001      .000      .000
LONGSHORE STATION    25
Y         .740    34.553    74.254 148.171 357.355 617.401 760.9851050.4141656.502
QX        .000      .000      .002      .017    -.014      .000      .000      .000      .000
QY       -.001     -.004     -.007     -.009    -.005     -.001      .001      .000      .000
LONGSHORE STATION    26
Y         .756    34.618    74.371 148.354 358.244 618.022 760.9951050.4141656.502
QX        .000      .000      .001      .005    -.005      .000      .000      .000      .000
QY       -.001     -.004     -.007     -.008    -.005     -.001      .001      .000      .001
LONGSHORE STATION    27
Y         .738    34.552    74.233 148.143 357.348 617.401 760.9951050.4141656.502
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QX        .000     .000    -.001    -.007     .004     .000     .000     .000     .000
QY       -.001    -.004    -.007    -.008    -.005    -.001     .001     .000     .000
LONGSHORE STATION    28
Y         .688   34.368   73.868  147.556  354.720  612.949  760.3751050.4141656.502
QX        .000     .000    -.002    -.018     .013     .000     .000     .000     .000
QY       -.001    -.004    -.006    -.008    -.005    -.001     .001     .000     .000
LONGSHORE STATION    29
Y         .610   34.082   73.293  146.642  350.497  605.882  760.9631050.4141656.502
QX        .000     .000    -.004    -.029     .022     .000     .000     .000     .000
QY       -.001    -.004    -.006    -.007    -.004    -.001     .001     .000     .000
LONGSHORE STATION    30
Y         .514   33.720   72.559  145.470  344.893  596.661  760.9481050.4141656.502
QX        .000    -.001    -.005    -.039     .029     .000     .000     .000     .000
QY       -.001    -.003    -.005    -.006    -.004    -.001     .000     .000     .000
LONGSHORE STATION    31
Y         .406   33.309   71.719  144.120  338.170  585.807  760.9291050.4141656.502
QX        .000    -.001    -.006    -.048     .035     .000     .000     .000     .000
QY       -.001    -.003    -.004    -.005    -.004    -.001     .000     .000     .000
LONGSHORE STATION    32
Y         .294   32.875   70.824  142.671  330.614  573.839  760.9091050.4141656.502
QX        .000    -.001    -.007    -.055     .040     .000     .000     .000     .000
QY       -.001    -.002    -.003    -.004    -.004    -.001     .000     .000     .000
LONGSHORE STATION    33
Y         .183   32.442   69.921  141.196  322.514  561.228  760.8881050.4141656.502
QX        .000    -.001    -.007    -.061     .043     .000     .000     .000     .000
QY        .000    -.001    -.002    -.003    -.003     .000     .000     .000     .000
LONGSHORE STATION    34
Y         .079   32.025   69.047  139.757  314.143  54[illegible]  760.8[illegible]1050.4141656.502
QX        .000    -.001    -.008    -.065     .044  [illegible]     .000     .000     .000
QY        .000    -.001  [illegible]  [illegible]  [illegible]  [illegible]     .000     .000     .000
LONGSHORE STATION    35
Y        -.012   31.640   68.232  138.406  305.777  535.653  760.9451050.4141656.502
QX        .000    -.001  [illegible]    -.067     .045  [illegible]     .000     .000     .000
QY        .000     .000     .000    -.001    -.003  [illegible]     .000  [illegible]  [illegible]
LONGSHORE STATION    36
Y        -.103   31.236   67.504  137.188  297.636  520.134  76[illegible]1050.4141656.502
QX      [illegible]    -.001    -.008    -.067     .044  [illegible]  [illegible]  [illegible]  [illegible]
QY      [illegible]     .000     .000  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
LONGSHORE STATION    37
Y        -.175  [illegible]  66.[illegible]  136.141  [illegible]  [illegible]  [illegible]1050.4141656.[illegible]
QX      [illegible]  [illegible]    -.008  [illegible]     .041  [illegible]  [illegible]  [illegible]  [illegible]
QY        .000  [illegible]     .001  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
LONGSHORE STATION    [illegible]
Y       [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
QX      [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
QY      [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
LONGSHORE STATION    [illegible]
Y        -.271  [illegible]  [illegible]  134.[illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
QX        .000  [illegible]  [illegible]  [illegible]     .034  [illegible]  [illegible]  [illegible]  [illegible]
QY        .000  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
LONGSHORE STATION    40
Y        -.291  [illegible]  65.52[illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
QX        .000    -.001  [illegible]    -.058  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
QY        .000  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
LONGSHORE STATION    41
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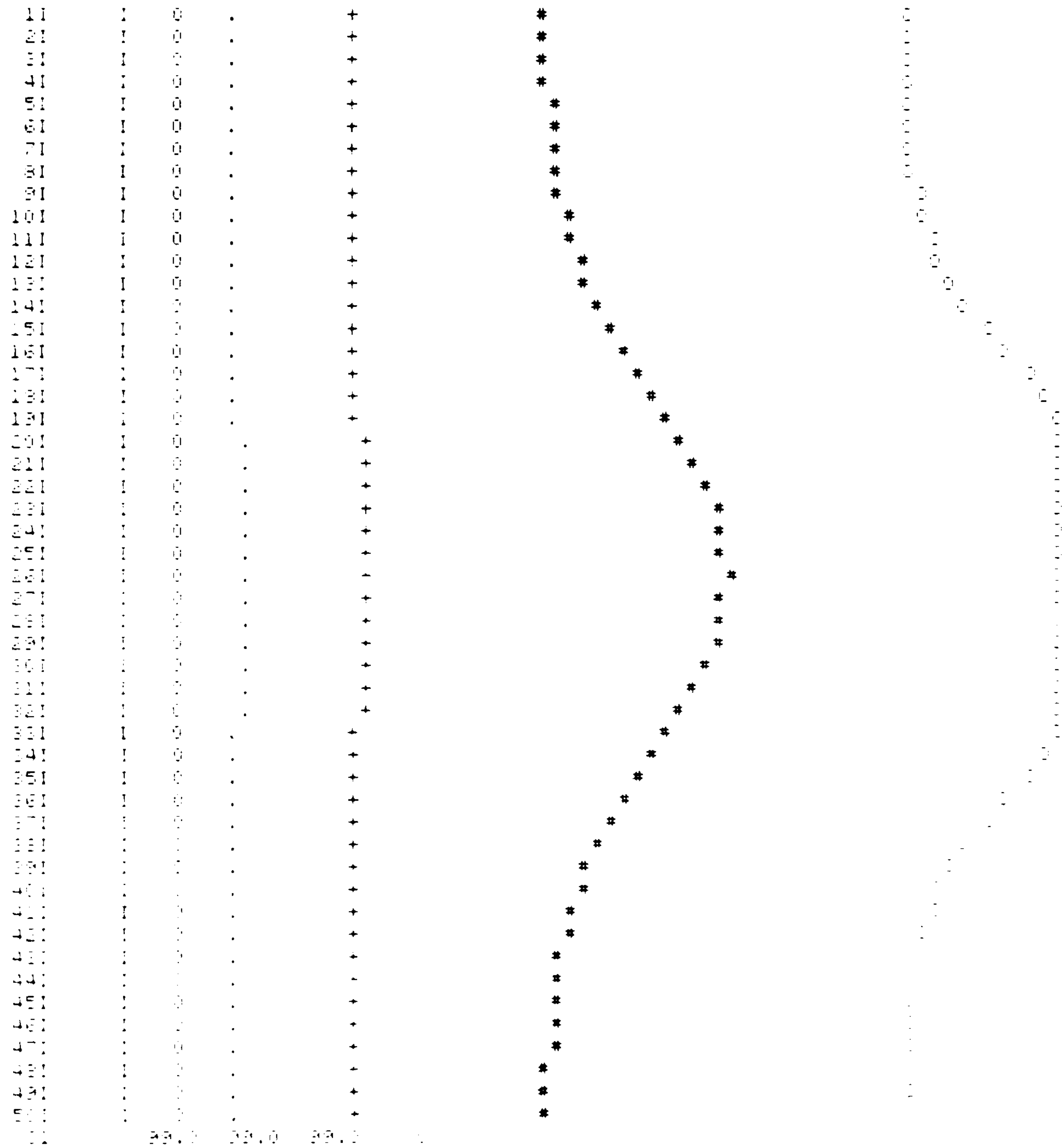
```
Y        -.292  30.506  65.763 134.127 266.472 479.447 760.7491050.4141656.502
QX        .000   -.001   -.005   -.051    .026    .000    .000    .000    .000
QY        .000    .002    .002    .003   -.001    .000    .000    .000    .000
LONGSHORE STATION   42
Y        -.277  30.548  65.824 134.173 262.760 473.751 760.7411050.4141656.502
QX        .000    .000   -.005   -.045    .021    .000    .000    .000    .000
QY        .000    .002    .002    .003   -.001    .000    .000    .000    .000
LONGSHORE STATION   43
Y        -.249  30.640  65.989 134.393 259.858 470.365 760.7351050.4141656.502
QX        .000    .000   -.004   -.040    .017    .000    .000    .000    .000
QY        .000    .001    .002    .003    .000    .000    .000    .000    .000
LONGSHORE STATION   44
Y        -.213  30.767  66.230 134.744 257.670 468.063 760.7311050.4141656.502
QX        .000    .000   -.003   -.035    .013    .000    .000    .000    .000
QY        .000    .001    .002    .002    .000    .000    .000    .000    .000
LONGSHORE STATION   45
Y        -.173  30.914  66.519 135.183 256.076 466.594 760.7291050.4141656.502
QX        .000    .000   -.003   -.030    .010    .000    .000    .000    .000
QY        .000    .001    .002    .002    .000    .000    .000    .000    .000
LONGSHORE STATION   46
Y        -.132  31.066  66.830 135.673 254.952 465.715 760.7271050.4141656.502
QX        .000    .000   -.002   -.026    .007    .000    .000    .000    .000
QY        .000    .001    .001    .002    .000    .000    .000    .000    .000
LONGSHORE STATION   47
Y        -.094  31.216  67.144 136.183 254.180 465.224 760.7271050.4141656.502
QX        .000    .000   -.002   -.022    .005    .000    .000    .000    .000
QY        .000    .001    .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION   48
Y        -.060  31.358  67.452 136.695 253.654 464.966 760.7261050.4141656.502
QX        .000    .000   -.001   -.020    .004    .000    .000    .000    .000
QY        .000    .000    .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION   49
Y        -.029  31.493  67.750 137.202 253.281 464.395 760.7261051.4141656.512
QX        .000    .000   -.001   -.019    .003    .000    .000    .000    .000
QY        .000    .000    .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION   50
Y         .001  31.623  68.041 137.706 252.932 464.755 760.7261051.4141656.512
QX        .000    .000   -.001   -.017    .002    .000    .000    .000    .000
QY        .000    .000    .000    .000    .000    .000    .000    .000    .000
```



EXAMPLE 4 - INPUT

```
      50          6
             10.000
  1.000    2.000    3.000    5.000    7.000   11.000   14.000   17.000   25.000   32.809
   .000     .000     .000     .000     .000     .000     .000     .000     .000     .000
      30
               5.000       .0500        .220
1
3        .000
   .1500
 100.000 21600.000
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    1
                   25         31    250.00      250.00
    1          5.0    8.0   30.0     0
    2          5.0    8.0   30.0     0
    3          5.0    8.0   30.0     0
    4          5.0    8.0   30.0     0
    5          5.0    8.0   30.0     0
    6          5.0    8.0   30.0     0
    7          5.0    8.0   30.0     0
    8          5.0    8.0   30.0     0
    9          5.0    8.0   30.0     0
   10          5.0    8.0   30.0     0
   11          5.0    8.0   30.0     0
   12          5.0    8.0   30.0     0
   13          5.0    8.0   30.0     0
   14          5.0    8.0   30.0     0
   15          5.0    8.0   30.0     0
   16          5.0    8.0   30.0     0
   17          5.0    8.0   30.0     0
   18          5.0    8.0   30.0     0
   19          5.0    8.0   30.0     0
   20          5.0    8.0   30.0     0
   21          5.0    8.0   30.0     0
   22          5.0    8.0   30.0     0
   23          5.0    8.0   30.0     0
   24          5.0    8.0   30.0     0
   25          5.0    8.0   30.0     0
   26          5.0    8.0   30.0     0
   27          5.0    8.0   30.0     0
   28          5.0    8.0   30.0     0
   29          5.0    8.0   30.0     0
   30          5.0    8.0   30.0     0
   31         99.0   99.0   99.0     0
```

EXAMPLE 4 - SPOOL: NONE

EXAMPLE 4 - OUTPUT

```
********************************************************
 THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=      32.809
********************************************************
 THE HEIGHT OF THE BERM, BERM=        5.000
 THE SLOPE OF THE BEACH FACE, SFACE=        .0500
 THE SEDIMENT DIAMETER, DIAM=         .220
********************************************************
 THE LENGTH OF THE STRUCTURE, SJETTY=         .000
 THE NUMBER    1 GROIN IS LOCATED AT GRID    3
********************************************************
 THE VALUE OF ADEAN=       .1500  IN THE EQ. H=AY**2/3
********************************************************
 THE VALUE OF THE LONGSHORE SPACE-STEP, DX=     100.000
 THE TIME-STEP IN SECONDS, DELT=  21600.000
********************************************************
  THE INITIAL SHORELINE COORDINATES :
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
********************************************************
 THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.35
     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.35
********************************************************
 THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
   1.00     2.00     3.00     5.00     7.00    11.00    14.00    17.00    25.00    32.81
********************************************************
********************************************************
BREAKWATER  LEFT LOC  RIGHT LOC  LEFT Y-VALUE  RIGHT Y-VALUE
    1          25         31          250.00          250.00
********************************************************
    1          5.0    8.0   30.0     0
    2          5.0    8.0   30.0     0
    3          5.0    8.0   30.0     0
    4          5.0    8.0   30.0     0
    5          5.0    8.0   30.0     0
    6          5.0    8.0   30.0     0
    7          5.0    8.0   30.0     0
    8          5.0    8.0   30.0     0
    9          5.0    8.0   30.0     0
   10          5.0    8.0   30.0     0
   11          5.0    8.0   30.0     0
   12          5.0    8.0   30.0     0
   13          5.0    8.0   30.0     0
   14          5.0    8.0   30.0     0
   15          5.0    8.0   30.0     0
   16          5.0    8.0   30.0     0
   17          5.0    8.0   30.0     0
   18          5.0    8.0   30.0     0
   19          5.0    8.0   30.0     0
   20          5.0    8.0   30.0     0
   21          5.0    8.0   30.0     0
```

```
  22         5.0    8.0   30.0     0
  23         5.0    8.0   30.0     0
  24         5.0    8.0   30.0     0
  25         5.0    8.0   30.0     0
  26         5.0    8.0   30.0     0
  27         5.0    8.0   30.0     0
  28         5.0    8.0   30.0     0
  29         5.0    8.0   30.0     0
  30         5.0    8.0   30.0     0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=     30

LONGSHORE STATION     1
Y          .000  31.623   68.041 137.706 252.982 464.758 760.7261050.4141656.502
QX         .001    .025     .146   1.443   2.257    .518     .000     .000     .000
QY         .000    .000     .000    .000    .000    .000     .000     .000     .000
LONGSHORE STATION     2
Y          .106  32.027   68.786 138.894 254.313 464.803 760.7261050.4141656.502
QX         .001    .025     .146   1.443   2.257    .518     .000     .000     .000
QY         .000    .000     .000    .000    .000    .000     .000     .000     .000
LONGSHORE STATION     3
Y          .181  32.279   69.317 139.853 255.564 464.826 760.7261050.4141656.502
QX         .001    .024     .144   1.432   2.251    .517     .000     .000     .000
QY         .000    .000    -.001   -.001    .000    .000     .000     .000     .000
LONGSHORE STATION     4
Y          .230  32.431   69.714 140.692 256.792 464.833 760.7261050.4141656.502
QX         .001    .024     .144   1.431   2.250    .517     .000     .000     .000
QY         .000   -.001    -.001   -.001    .000    .000     .000     .000     .000
LONGSHORE STATION     5
Y          .268  32.576   70.112 141.561 258.028 464.823 760.7261050.4141656.502
QX         .001    .024     .144   1.427   2.247    .517     .000     .000     .000
QY         .000   -.001    -.001   -.002    .000    .000     .000     .000     .000
LONGSHORE STATION     6
Y          .306  32.742   70.555 142.511 259.323 464.805 760.7261050.4141656.502
QX         .001    .024     .143   1.422   2.243    .517     .000     .000     .000
QY         .000   -.001    -.001   -.002    .000    .000     .000     .000     .000
LONGSHORE STATION     7
Y          .349  32.941   71.067 143.569 260.680 464.751 760.7261050.4141656.502
QX         .001    .024     .142   1.415   2.237    .518     .000     .000     .000
QY         .000   -.001    -.002   -.003    .000    .000     .000     .000     .000
LONGSHORE STATION     8
Y          .402  33.181   71.665 144.759 262.111 464.647 760.7261050.4141656.502
QX         .001    .023     .142   1.406   2.231    .519     .000     .000     .000
QY         .000   -.001    -.002   -.003    .000    .000     .000     .000     .000
LONGSHORE STATION     9
Y          .468  33.471   72.364 146.106 263.625 464.466 760.7251050.4141656.502
QX         .001    .023     .141   1.396   2.224    .519     .000     .000     .000
QY         .000   -.001    -.002   -.004    .000    .000     .000     .000     .000
LONGSHORE STATION    10
Y          .550  33.820   73.181 147.628 265.223 464.165 760.7241050.4141656.502
QX         .001    .023     .140   1.384   2.215    .521     .000     .000     .000
QY        -.001   -.002    -.003   -.005    .000    .000     .000     .000     .000
LONGSHORE STATION    11
Y          .652  34.238   74.134 149.348 266.325 463.887 760.7211050.4141656.502
QX         .000    .023     .139   1.370   2.206    .523     .000     .000     .000
QY        -.001   -.002    -.003   -.005    .000    .001     .000     .000     .000
```

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LONGSHORE STATION   12
Y        .777  34.735  75.240 151.279 268.717 462.951 760.7151050.4141656.502
QX       .000    .023    .138   1.355   2.136    .526    .000    .000    .000
QY     -.001   -.002   -.004   -.006    .000    .001    .000    .000    .000
LONGSHORE STATION   13
Y        .928  35.321  76.513 153.435 270.600 461.350 760.7031050.4141656.502
QX       .000    .023    .136   1.338   2.184    .531    .000    .000    .000
QY     -.001   -.003   -.005   -.007    .000    .001    .000    .000    .000
LONGSHORE STATION   14
Y       1.107  36.007  77.968 155.819 272.564 460.244 760.6771050.4141656.502
QX       .000    .022    .135   1.319   2.172    .537    .000    .000    .000
QY     -.001   -.003   -.005   -.008    .000    .001    .000    .000    .000
LONGSHORE STATION   15
Y       1.314  36.800  78.614 158.431 274.539 457.956 760.6261050.4141656.502
QX       .000    .022    .133   1.298   2.159    .546    .000    .000    .000
QY     -.001   -.004   -.006   -.009    .000    .001    .000    .000    .000
LONGSHORE STATION   16
Y       1.552  37.710  81.458 161.259 276.641 454.765 760.5271050.4141656.502
QX       .000    .022    .130   1.276   2.146    .557    .000    .000    .000
QY     -.001   -.004   -.007   -.010    .000    .001    .000    .000    .000
LONGSHORE STATION   17
Y       1.926  38.739  83.497 164.281 278.669 450.407 760.3471050.4131656.502
QX       .000    .021    .128   1.252   2.132    .572    .000    .000    .000
QY     -.002   -.005   -.008   -.011    .000    .001    .000    .000    .000
LONGSHORE STATION   18
Y       2.144  39.889  85.722 167.463 280.598 444.563 760.0381050.4121656.502
QX     -.001    .021    .124   1.226   2.119    .590    .000    .000    .000
QY     -.002   -.006   -.009   -.012    .000    .002    .000    .000    .000
LONGSHORE STATION   19
Y       2.508  41.151  88.107 170.756 282.325 437.259 759.5371050.4101656.502
QX     -.001    .020    .120   1.198   2.106    .612    .000    .000    .000
QY     -.002   -.007   -.010   -.013    .000    .002    .000    .000    .000
LONGSHORE STATION   20
Y       2.926  42.512  90.620 174.093 283.737 426.374 758.7741050.4081656.502
QX     -.001    .019    .116   1.168   2.100    .638    .000    .000    .000
QY     -.003   -.008   -.012   -.014    .000    .002    .000    .000    .000
LONGSHORE STATION   21
Y       3.416  43.974  93.230 177.367 284.748 414.217 757.[illegible]1050.4141656.502
QX     -.001    .018    .111   1.136   2.093    .667 [illegible] [illegible] [illegible]
QY     -.003   -.009   -.013   -.014    .000 [illegible] [illegible] [illegible] [illegible]
LONGSHORE STATION   22
Y       4.015  45.637  96.037 180.581 285.315 398.[illegible] 756.[illegible]
QX     -.001    .017    .104   1.094   2.101    .696    .000    .000    .000
QY     -.003   -.010   -.014   -.015    .001    .004   -.001    .000    .000
LONGSHORE STATION   23
Y       4.763  47.342  99.405 183.502 285.625 380.517 754.[illegible]1656.502
QX     -.001    .016    .098   1.077   2.101    .720    .000    .000    .000
QY     -.004   -.011   -.015   -.014    .001    .004   -.001    .000    .000
LONGSHORE STATION   24
Y       5.631  51.416 105.304 189.464 286.139 359.090 752.145[illegible]1656.502
QX     -.001    .016    .095    .888   2.091    .749    .000    .000    .000
QY     -.004   -.014   -.017   -.014    .001    .005   -.001    .000    .000
LONGSHORE STATION   25
Y       6.693  56.566 116.475 207.211 288.663 345.391 741.[illegible]1656.502
QX     -.001    .020    .099   1.026   2.058    .667    .000    .000    .000
```

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QY        -.004   -.018   -.023   -.021    .035    .005   -.001    .000    .000
LONGSHORE STATION    26
Y         7.413  61.916 132.515 239.425 295.163 353.884 747.0461050.3711656.502
QX         .000    .016    .098   1.099   2.071   1.696    .002    .000    .000
QY        -.004   -.023   -.034   -.038    .064    .005   -.001    .000    .000
LONGSHORE STATION    27
Y         7.339  64.567 144.727 268.898 307.970 371.959 745.3371050.3621656.502
QX         .001    .017    .104   1.058   1.930   1.286    .010    .000    .000
QY        -.004   -.025   -.044   -.055    .039    .005   -.001    .000    .000
LONGSHORE STATION    28
Y         5.944  60.276 137.822 267.488 321.795 390.866 746.4331050.3531656.502
QX         .001    .012    .048    .680   1.900   1.464    .029    .000    .000
QY        -.003   -.023   -.041   -.060    .084    .005   -.001    .000    .000
LONGSHORE STATION    29
Y         3.142  47.249 106.166 217.554 309.133 410.420 752.7411050.3581656.502
QX         .001    .002   -.016    .289   1.264   1.642    .064    .000    .000
QY        -.001   -.012   -.022   -.042    .043    .030    .000    .000    .000
LONGSHORE STATION    30
Y         -.513  29.080  61.607 131.945 245.105 434.627 766.2121050.4061656.502
QX         .000   -.002   -.026   -.103   -.589   1.281    .106    .000    .000
QY         .000    .002    .004   -.001    .000    .024    .000    .000    .000
LONGSHORE STATION    31
Y        -4.065  12.297  23.150  56.465 164.924 435.037 779.1381050.4771656.502
QX         .000    .001   -.001   -.001   -.817   4.485    .202    .001    .000
QY         .002    .015    .025    .036   -.015   -.037    .000    .000    .000
LONGSHORE STATION    32
Y        -6.652   1.649   3.467  22.570 125.338 401.543 780.6081050.5021656.502
QX         .001    .013    .053    .467    .969    .474    .000    .000    .000
QY         .003    .023    .037    .050   -.011    .002   -.001    .000    .000
LONGSHORE STATION    33
Y        -7.940  -1.650    .169  20.441 134.104 38[illegible].72 775.2211050.4341656.502
QX         .002    .024    .099    .767   2.519   1.375    .001    .000    .000
QY         .004    .025    .038    .049   -.010   -.001   -.001    .000    .000
LONGSHORE STATION    34
Y        -8.135    .364   3.653  29.657 147.888 398.639 770.4721050.4611656.502
QX         .002    .025    .106    .741   2.138   1.669    .001    .000    .000
QY         .005    .023    .033    .044   -.008   -.001   -.001    .000    .000
LONGSHORE STATION    35
Y        -7.634   3.338   9.982  40.649 157.346 404.660 766.8831050.4441656.502
QX         .002    .025    .106    .770   2.288   1.964    .001    .000    .000
QY         .005    .020    .030    .039   -.004   -.001   -.001    .000    .000
LONGSHORE STATION    36
Y        -6.772   6.760  16.755  51.416 165.954 411.137 764.3381050.4321656.502
QX         .002    .026    .108    .835   2.393   1.8[illegible]    .[illegible]    .000    .000
QY         .005    .018    .026    .035    .000   -.001    .000    .000    .000
LONGSHORE STATION    37
Y        -5.775  10.186  23.347  61.550 173.130 417.135 762.7471050.4241656.502
QX         .002    .025    .110    .883   2.444   2.042    .001    .000    .000
QY         .005    .015    .023    .032    .004   -.001    .000    .000    .000
LONGSHORE STATION    38
Y        -4.788  13.398  29.458  70.887 180.111 423.202 761.7421050.4201656.502
QX         .002    .025    .112    .928   2.466   2.083    .001    .000    .000
QY         .004    .013    .020    .029    .007   -.001    .000    .000    .000
LONGSHORE STATION    39
Y        -3.886  16.303  35.005  79.450 186.840 428.619 761.1721050.4171656.502
```
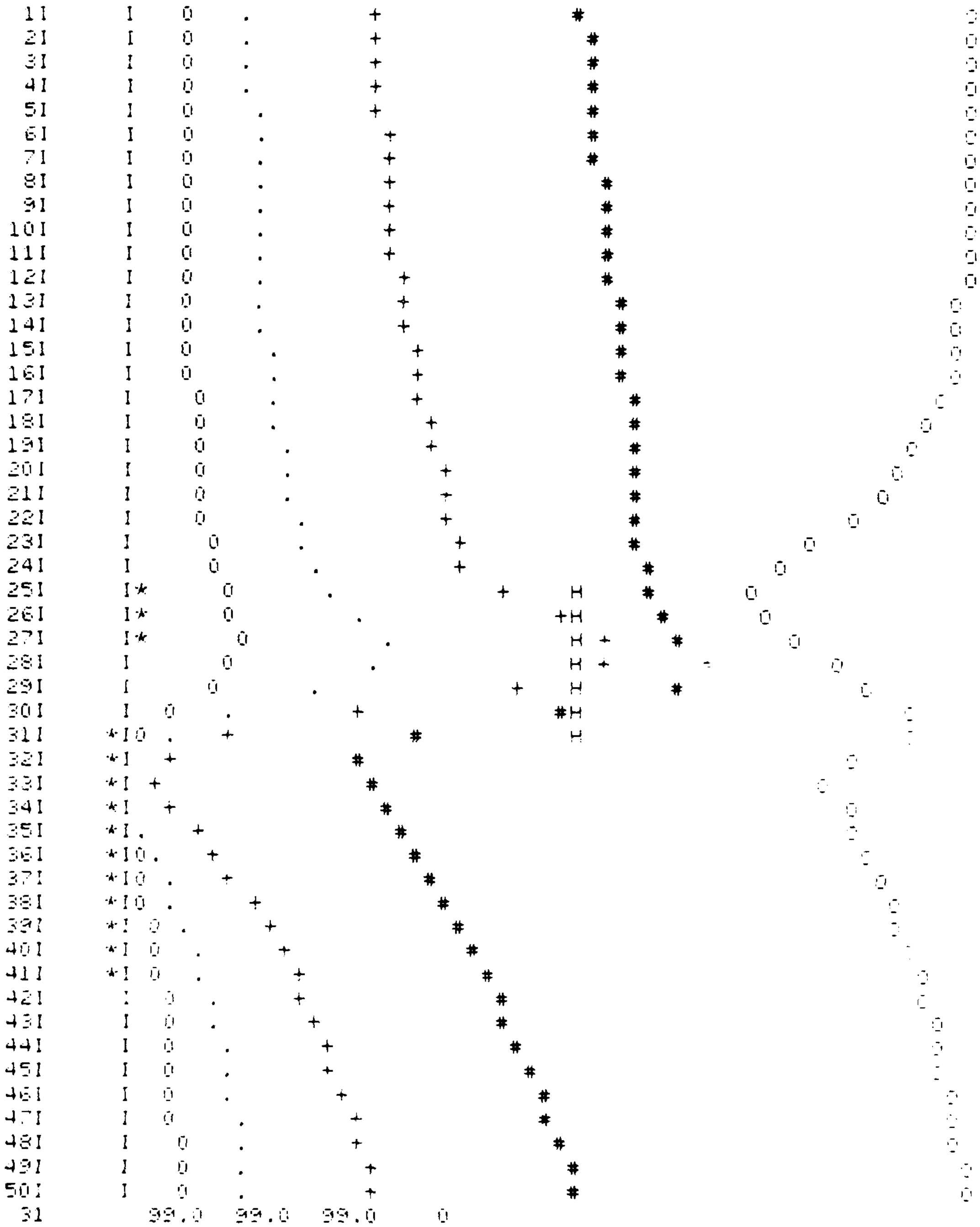

QX	.002	.025	.114	.969	2.475	2.123	.001	.000	.000
QY	.004	.011	.018	.025	.009	-.001	.000	.000	.000
LONGSHORE STATION 40									
Y	-3.103	18.873	39.981	87.288	193.457	433.634	760.877	1050.416	1656.502
QX	.002	.025	.116	1.007	2.482	2.161	.001	.000	.000
QY	.003	.009	.015	.022	.010	-.001	.000	.000	.000
LONGSHORE STATION 41									
Y	-2.443	21.115	44.412	94.443	199.963	438.240	760.740	1050.415	1656.502
QX	.002	.025	.117	1.041	2.493	2.198	.001	.000	.000
QY	.003	.008	.013	.019	.010	-.001	.000	.000	.000
LONGSHORE STATION 42									
Y	-1.898	23.055	48.343	100.957	206.366	442.428	760.686	1050.415	1656.502
QX	.002	.025	.119	1.071	2.508	2.231	.001	.000	.000
QY	.002	.007	.011	.017	.010	-.001	.000	.000	.000
LONGSHORE STATION 43									
Y	-1.454	24.728	51.828	106.886	212.644	446.208	760.673	1050.414	1656.502
QX	.002	.025	.120	1.095	2.528	2.261	.001	.000	.000
QY	.002	.005	.009	.014	.010	-.001	.000	.000	.000
LONGSHORE STATION 44									
Y	-1.092	26.171	54.925	112.297	218.771	449.608	760.676	1050.414	1656.502
QX	.002	.024	.120	1.116	2.549	2.287	.001	.000	.000
QY	.002	.004	.008	.012	.009	-.001	.000	.000	.000
LONGSHORE STATION 45									
Y	-.799	27.419	57.690	117.265	224.735	452.665	760.684	1050.414	1656.502
QX	.002	.024	.121	1.133	2.569	2.308	.001	.000	.000
QY	.001	.003	.006	.010	.008	-.001	.000	.000	.000
LONGSHORE STATION 46									
Y	-.562	28.509	60.182	121.862	230.537	455.428	760.693	1050.414	1656.502
QX	.002	.024	.121	1.146	2.589	2.326	.001	.000	.000
QY	.001	.002	.005	.008	.007	.000	.000	.000	.000
LONGSHORE STATION 47									
Y	-.370	29.472	62.456	126.165	236.194	457.946	760.702	1050.414	1656.502
QX	.002	.024	.121	1.156	2.605	2.341	.001	.000	.000
QY	.001	.002	.003	.006	.005	.000	.000	.000	.000
LONGSHORE STATION 48									
Y	-.217	30.329	64.555	130.241	241.740	460.272	760.709	1050.414	1656.502
QX	.002	.024	.122	1.163	2.618	2.352	.001	.000	.000
QY	.000	.001	.002	.004	.004	.000	.000	.000	.000
LONGSHORE STATION 49									
Y	-.098	31.049	66.426	134.087	247.300	462.505	760.717	1050.414	1656.502
QX	.002	.024	.122	1.169	2.624	2.357	.001	.000	.000
QY	.000	.000	.001	.002	.002	.000	.000	.001	.000
LONGSHORE STATION 50									
Y	.000	31.623	68.041	137.706	252.982	464.759	760.726	1050.414	1656.502
QX	.002	.023	.120	1.166	2.639	2.365	.001	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000



EXAMPLE 5 - INPUT

```
      50            8
           10.000
   1.000   2.000   3.000   5.000   7.000  11.000  14.000  17.000  25.000  32.908
    .000    .000    .000    .000    .000    .000    .000    .000    .000    .000
      30
            5.000     .0500     .220
 1
33  250.000
    .1500
 100.000 21600.000
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
   2
                   18        22   300.00    300.00
                   24        28   300.00    300.00
   1        4.0    6.0   25.0     0
   2        4.0    6.0   25.0     0
   3        4.0    6.0   25.0     0
   4        4.0    6.0   25.0     0
   5        4.0    6.0   25.0     0
   6        4.0    6.0   25.0     0
   7        4.0    6.0   25.0     0
   8        4.0    6.0   25.0     0
   9        4.0    6.0   25.0     0
  10        4.0    6.0   25.0     0
  11        4.0    6.0   25.0     0
  12        4.0    6.0   25.0     0
  13        4.0    6.0   25.0     0
  14        4.0    6.0   25.0     0
  15        4.0    6.0   25.0     0
  16        4.0    6.0   25.0     0
  17        4.0    6.0   25.0     0
  18        4.0    6.0   25.0     0
  19        4.0    6.0   25.0     0
  20        4.0    6.0   25.0     0
  21        4.0    6.0   25.0     0
  22        4.0    6.0   25.0     0
  23        4.0    6.0   25.0     0
  24        4.0    6.0   25.0     0
  25        4.0    6.0   25.0     0
  26        4.0    6.0   25.0     0
  27        4.0    6.0   25.0     0
  28        4.0    6.0   25.0     0
  29        4.0    6.0   25.0     0
  30        4.0    6.0   25.0     0
  31       99.0   99.0   99.0     0
```

EXAMPLE 5 - SPOOL: NONE

EXAMPLE 5 - OUTPUT

```
********************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=      32.808
********************************************************
  THE HEIGHT OF THE BERM, BERM=       5.000
  THE SLOPE OF THE BEACH FACE, SFACE=       .0500
  THE SEDIMENT DIAMETER, DIAM=        .220
********************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=     250.000
  THE NUMBER     1 GROIN IS LOCATED AT GRID    33
********************************************************
  THE VALUE OF ADEAN=       .1500   IN THE EQ. H=AY**2/3
********************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    100.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
********************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
********************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00    31.62    68.04  137.71   252.98   464.76   760.73 1050.41 1656.50 2674.85
     .00    31.62    68.04  137.71   252.98   464.76   760.73 1050.41 1656.50 2674.85
********************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
    1.00     2.00     3.00     5.00     7.00    11.00    14.00    17.00    25.00    32.81
********************************************************
********************************************************
 BREAKWATER  LEFT LOC  RIGHT LOC  LEFT Y VALUE  RIGHT Y VALUE
      1         18         22          300.00         300.00
      2         24         28          300.00         300.00
********************************************************
    1          4.0   6.0  25.0     0
    2          4.0   6.0  25.0     0
    3          4.0   6.0  25.0     0
    4          4.0   6.0  25.0     0
    5          4.0   6.0  25.0     0
    6          4.0   6.0  25.0     0
    7          4.0   6.0  25.0     0
    8          4.0   6.0  25.0     0
    9          4.0   6.0  25.0     0
   10          4.0   6.0  25.0     0
   11          4.0   6.0  25.0     0
   12          4.0   6.0  25.0     0
   13          4.0   6.0  25.0     0
   14          4.0   6.0  25.0     0
   15          4.0   6.0  25.0     0
   16          4.0   6.0  25.0     0
   17          4.0   6.0  25.0     0
   18          4.0   6.0  25.0     0
   19          4.0   6.0  25.0     0
   20          4.0   6.0  25.0     0
```

```
  21        4.0    6.0   25.0     0
  22        4.0    6.0   25.0     0
  23        4.0    6.0   25.0     0
  24        4.0    6.0   25.0     0
  25        4.0    6.0   25.0     0
  26        4.0    6.0   25.0     0
  27        4.0    6.0   25.0     0
  28        4.0    6.0   25.0     0
  29        4.0    6.0   25.0     0
  30        4.0    6.0   25.0     0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=     30

LONGSHORE STATION     1
Y          .000  31.623   68.041 137.706 252.982 464.758 760.7261050.4141656.502
QX         .001    .029     .154   1.173   1.178    .089    .000     .000     .000
QY         .000    .000     .000    .000    .000    .000    .000     .000     .000
LONGSHORE STATION     2
Y          .365  33.172   71.497 143.456 257.058 464.852 760.7251050.4141656.502
QX         .001    .029     .154   1.173   1.178    .089    .000     .000     .000
QY         .000   -.001    -.002   -.002    .000    .000    .000     .000     .000
LONGSHORE STATION     3
Y          .704  34.570   74.537 148.621 260.890 464.894 760.7241050.4141656.502
QX         .001    .028     .150   1.144   1.170    .088    .000     .000     .000
QY        -.001   -.002    -.003   -.004    .000    .000    .000     .000     .000
LONGSHORE STATION     4
Y         1.027  35.871   77.355 153.501 264.551 464.853 760.7221050.4141656.502
QX         .001    .027     .148   1.140   1.166    .087    .000     .000     .000
QY        -.001   -.003    -.005   -.006    .000    .000    .000     .000     .000
LONGSHORE STATION     5
Y         1.361  37.203   80.256 158.493 268.204 464.740 760.7141050.4141656.502
QX         .001    .027     .146   1.127   1.162    .087    .000     .000     .000
QY        -.001   -.004    -.007   -.009    .000    .000    .000     .000     .000
LONGSHORE STATION     6
Y         1.730  38.654   83.365 163.713 271.920 464.553 760.6961050.4141656.502
QX         .001    .027     .144   1.108   1.155    .087    .000     .000     .000
QY        -.002   -.005    -.008   -.011    .000    .000    .000     .000     .000
LONGSHORE STATION     7
Y         2.158  40.280   86.749 169.224 275.722 464.250 760.6541050.4141656.502
QX         .001    .026     .141   1.086   1.147    .088    .000     .000     .000
QY        -.002   -.006    -.010   -.013    .000    .000    .000     .000     .000
LONGSHORE STATION     8
Y         2.664  42.119   90.455 175.068 279.613 463.751 760.5681050.4131656.502
QX         .001    .026     .138   1.060   1.139    .088    .000     .000     .000
QY        -.003   -.008    -.012   -.015    .000    .000    .000     .000     .000
LONGSHORE STATION     9
Y         3.266  44.196   94.512 181.269 283.570 462.938 760.4031050.4111656.502
QX         .001    .025     .135   1.030   1.129    .089    .000     .000     .000
QY        -.003   -.009    -.014   -.017    .001    .000    .000     .000     .000
LONGSHORE STATION    10
Y         3.976  46.528   98.934 187.828 287.549 461.644 760.1111050.4071656.502
QX         .001    .025     .130    .997   1.118    .091    .000     .000     .000
QY        -.004   -.011    -.016   -.019    .001    .000    .000     .000     .000
LONGSHORE STATION    11
Y         4.801  49.118  103.725 194.728 291.478 459.644 759.6331050.4021656.502
QX         .001    .024     .126    .960   1.106    .093    .000     .000     .000
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QY       -.004   -.012   -.018   -.021    .001    .001    .000    .000    .000
LONGSHORE STATION   12
Y        5.735  51.962 108.889 201.942 295.305 456.657 758.9041050.3941656.502
QX        .000    .023    .120    .921   1.092    .096    .000    .000    .000
QY       -.005   -.014   -.020   -.023    .001    .001    .000    .000    .000
LONGSHORE STATION   13
Y        6.753  55.044 114.432 209.441 299.136 452.370 757.8681050.3821656.502
QX        .000    .023    .114    .878   1.077    .099    .000    .000    .000
QY       -.005   -.016   -.023   -.025    .001    .001    .000    .000    .000
LONGSHORE STATION   14
Y        7.798  58.341 120.377 217.175 303.170 446.464 756.4941050.3641656.502
QX        .000    .022    .108    .835   1.069    .103    .000    .000    .000
QY       -.005   -.019   -.025   -.027    .001    .001    .000    .000    .000
LONGSHORE STATION   15
Y        8.779  61.831 126.808 225.173 307.402 438.645 754.7841050.3381656.502
QX        .000    .021    .100    .784   1.060    .107    .000    .000    .000
QY       -.006   -.021   -.028   -.029    .001    .001    .000    .000    .000
LONGSHORE STATION   16
Y        9.545  65.417 133.962 233.187 311.671 428.661 752.7821050.2991656.502
QX       -.001    .020    .091    .755   1.044    .110    .000    .000    .000
QY       -.006   -.024   -.032   -.030    .001    .001    .000    .000    .000
LONGSHORE STATION   17
Y        9.861  68.520 141.773 244.203 316.401 416.289 750.5741050.2381656.502
QX       -.001    .019    .083    .561   1.018    .112    .000    .000    .000
QY       -.006   -.027   -.037   -.033    .002    .001    .000    .000    .000
LONGSHORE STATION   18
Y        9.469  68.799 145.363 257.194 321.232 412.130 748.4581050.1461656.502
QX       -.001    .017    .087    .955   1.063    .094    .000    .000    .000
QY       -.006   -.027   -.040   -.042    .051    .002    .000    .000    .000
LONGSHORE STATION   19
Y        8.248  64.018 137.809 259.368 324.837 426.288 746.8461050.0151656.502
QX        .000    .002    .011    .502   1.028    .749    .006    .000    .000
QY       -.005   -.024   -.037   -.052    .049    .002    .000    .000    .000
LONGSHORE STATION   20
Y        6.343  55.264 119.345 237.038 325.574 447.954 745.8921049.8411656.502
QX        .000    .000   -.007    .307   1.121    .449    .012    .000    .000
QY       -.004   -.017   -.027   -.048    .026    .001    .000    .000    .000
LONGSHORE STATION   21
Y        4.152  45.145  95.621 191.412 319.149 470.835 745.6631049.6361656.502
QX        .000   -.001   -.013   -.075   1.067    .430    .023    .000    .000
QY       -.003   -.009   -.014   -.026   -.013    .001    .000    .000    .000
LONGSHORE STATION   22
Y        2.165  36.568  75.054 146.890 297.041 482.043 744.1061049.4301656.502
QX        .000    .001   -.003   -.071   1.024   1.138    .042    .000    .000
QY       -.002   -.003   -.002   -.002   -.035    .026    .000    .000    .000
LONGSHORE STATION   23
Y         .727  32.439  66.252 128.144 268.771 462.810 738.5451049.2701656.502
QX        .001    .009    .022    .126    .546    .024    .000    .000    .000
QY       -.001    .000    .003    .008   -.001    .000    .000    .000    .000
LONGSHORE STATION   24
Y        -.220  31.361  65.974 129.304 260.637 444.072 737.3051049.3551656.502
QX        .001    .019    .078    .567   1.022    .048    .000    .000    .000
QY       -.001    .000    .002    .006   -.015    .027    .000    .000    .000
LONGSHORE STATION   25
Y        -.936  29.681  64.483 131.703 275.104 455.825 748.8941049.8481656.502
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QX        .000     .002     .013     .180     .882    1.219     .228     .004     .000
QY        .000     .001     .002     .003    -.026     .029     .000     .000     .000
LONGSHORE STATION   26
Y       -1.442   27.681   62.014  133.384  287.194  479.465  766.1021050.5431656.502
QX        .000     .003     .018     .256     .864     .516     .171     .004     .000
QY        .000     .003     .002    -.001    -.038     .018     .000     .000     .000
LONGSHORE STATION   27
Y       -1.570   26.533   60.798  135.107  272.003  503.462  783.4091051.2051656.502
QX        .000     .003     .021     .272     .380     .560     .170     .004     .000
QY       -.001     .004     .002    -.004    -.023    -.019     .000     .000     .000
LONGSHORE STATION   28
Y       -1.095   26.643   61.803  138.627  238.260  520.237  795.1041051.6231656.502
QX        .000     .003     .019     .228     .234    1.027     .226     .004     .000
QY       -.001     .004     .001    -.007     .014    -.069     .000     .000     .000
LONGSHORE STATION   29
Y         .267   30.422   69.785  151.360  219.091  517.534  793.5391051.6351656.502
QX        .001     .009     .043     .323     .518     .092     .000     .000     .000
QY       -.002     .002    -.003    -.012     .002    -.001     .000     .000     .000
LONGSHORE STATION   30
Y        2.542   38.747   84.591  170.321  223.152  506.532  785.3851051.4131656.502
QX        .003     .030     .080     .311    1.088     .136     .000     .000     .000
QY       -.002    -.004    -.009    -.016     .003    -.001     .000     .000     .000
LONGSHORE STATION   31
Y        5.269   48.821  101.128  189.398  234.207  497.825  778.2011051.1561656.502
QX        .003     .028     .061     .206     .698     .121     .000     .000     .000
QY       -.003    -.012    -.016    -.018     .003    -.001     .000     .000     .000
LONGSHORE STATION   32
Y        7.806   58.975  118.130  209.319  243.452  49[illegible].357  772.3921050.9191656.502
QX        .003     .027     .056     .145     .793     .107     .000     .000     .000
QY       -.003    -.019    -.023    -.021     .003     .000     .000     .000     .000
LONGSHORE STATION   33
Y        9.423   66.781  131.815  225.751  256.820  484.381  768.0531050.7301656.502
QX        .003     .030     .084     .387     .574     .096     .000     .000     .000
QY       -.003    -.026    -.028    -.024     .003     .000     .000     .000     .000
LONGSHORE STATION   34
Y      -33.165  -29.559  -27.740  -25.209  234.217  477.793  765.0511050.5361656.502
QX        .000     .000     .000     .000    2.109     .096     .000     .000     .000
QY        .017     .064     .074     .029    -.006     .000     .000     .000     .000
LONGSHORE STATION   35
Y      -28.693  -25.071  -23.252  -20.718  169.807  469.[illegible]  763.1201050.5121656.502
QX        .001     .025     .114     .119     .001     .000     .000     .000     .000
QY        .018     .051     .062     .082    -.003    -.[illegible]     .000     .000     .000
LONGSHORE STATION   36
Y      -22.896  -19.181  -17.362  -12.182  144.147  464.135  761.3631050.4611656.502
QX        .000     .011     .072     .316    2.005     .158     .000     .000     .000
QY        .017     .041     .050     .063    -.002    -.[illegible]     .000     .000     .000
LONGSHORE STATION   37
Y      -17.720  -13.891  -12.072     .343  154.329  461.374  761.[illegible]1050.4171656.502
QX        .001     .018     .104     .366     .606     .065     .000     .000     .000
QY        .016     .037     .045     .056    -.002    -.001     .000     .000     .000
LONGSHORE STATION   38
Y      -13.146   -7.977   -6.364   13.997  162.035  461.522  760.3981050.4241656.502
QX        .001     .023     .121     .486     .275     .079     .000     .000     .000
QY        .012     .026     .035     .049    -.001    -.001     .000     .000     .000
LONGSHORE STATION   39
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Y      -10.234   -2.362    1.900   27.324 171.244 462.052 760.8401050.4181656.502
QX        .001     .026     .119     .558    .859    .086    .000    .000    .000
QY        .009     .024     .032     .044   -.001   -.001    .000    .000    .000
LONGSHORE STATION   40
Y       -8.165    2.765   10.135   41.304 180.374 462.858 760.7701050.4161656.502
QX        .002     .028     .123     .628    .890    .089    .000    .000    .000
QY        .007     .020     .029     .038   -.001   -.001    .000    .000    .000
LONGSHORE STATION   41
Y       -6.549    7.345   18.054   53.869 189.244 463.606 760.7411050.4151656.502
QX        .002     .029     .126     .693    .912    .091    .000    .000    .000
QY        .006     .017     .026     .034   -.001   -.001    .000    .000    .000
LONGSHORE STATION   42
Y       -5.231   11.400   25.430   65.555 197.752 464.183 760.7311050.4151656.502
QX        .002     .030     .129     .752    .934    .091    .000    .000    .000
QY        .005     .015     .022     .029   -.001   -.001    .000    .000    .000
LONGSHORE STATION   43
Y       -4.145   14.963   32.205   76.388 205.916 464.575 760.7271050.4141656.502
QX        .002     .030     .133     .805    .959    .091    .000    .000    .000
QY        .004     .012     .019     .025   -.001   -.001    .000    .000    .000
LONGSHORE STATION   44
Y       -3.249   18.088   38.384   86.432 213.676 464.815 760.7261050.4141656.502
QX        .002     .030     .137     .852    .984    .091    .000    .000    .000
QY        .003     .010     .016     .022    .000   -.001    .000    .000    .000
LONGSHORE STATION   45
Y       -2.505   20.836   44.011   95.770 220.947 464.944 760.7261050.4141656.502
QX        .002     .031     .140     .892   1.004    .091    .000    .000    .000
QY        .003     .008     .013     .018    .000    .000    .000    .000    .000
LONGSHORE STATION   46
Y       -1.880   23.272   49.153 104.509 227.767 465.004 760.7261050.4141656.502
QX        .002     .031     .143     .927   1.021    .091    .000    .000    .000
QY        .002     .006     .010     .014    .000    .000    .000    .000    .000
LONGSHORE STATION   47
Y       -1.343   25.476   53.891 112.751 234.257 465.046 760.7261050.4141656.502
QX        .002     .031     .145     .955   1.036    .090    .000    .000    .000
QY        .002     .005     .008     .011    .000    .000    .000    .000    .000
LONGSHORE STATION   48
Y        -.863   27.562   58.374 120.624 240.465 465.040 760.7261050.4141656.502
QX        .002     .031     .147     .975   1.049    .090    .000    .000    .000
QY        .001     .003     .006     .007    .000    .000    .000    .000    .000
LONGSHORE STATION   49
Y        -.420   29.609   62.996 128.749 246.537 464.922 760.7261050.4141656.502
QX        .002     .031     .148     .977   1.046    .087    .000    .000    .000
QY        .001     .002     .003     .004    .000    .000    .000    .000    .000
LONGSHORE STATION   50
Y         .000   31.623   68.041 137.706 252.982 464.759 760.7261050.4141656.502
QX        .002     .030     .153    1.024   1.066    .087    .000    .000    .000
QY        .000     .000     .000     .000    .000    .000    .000    .000    .000
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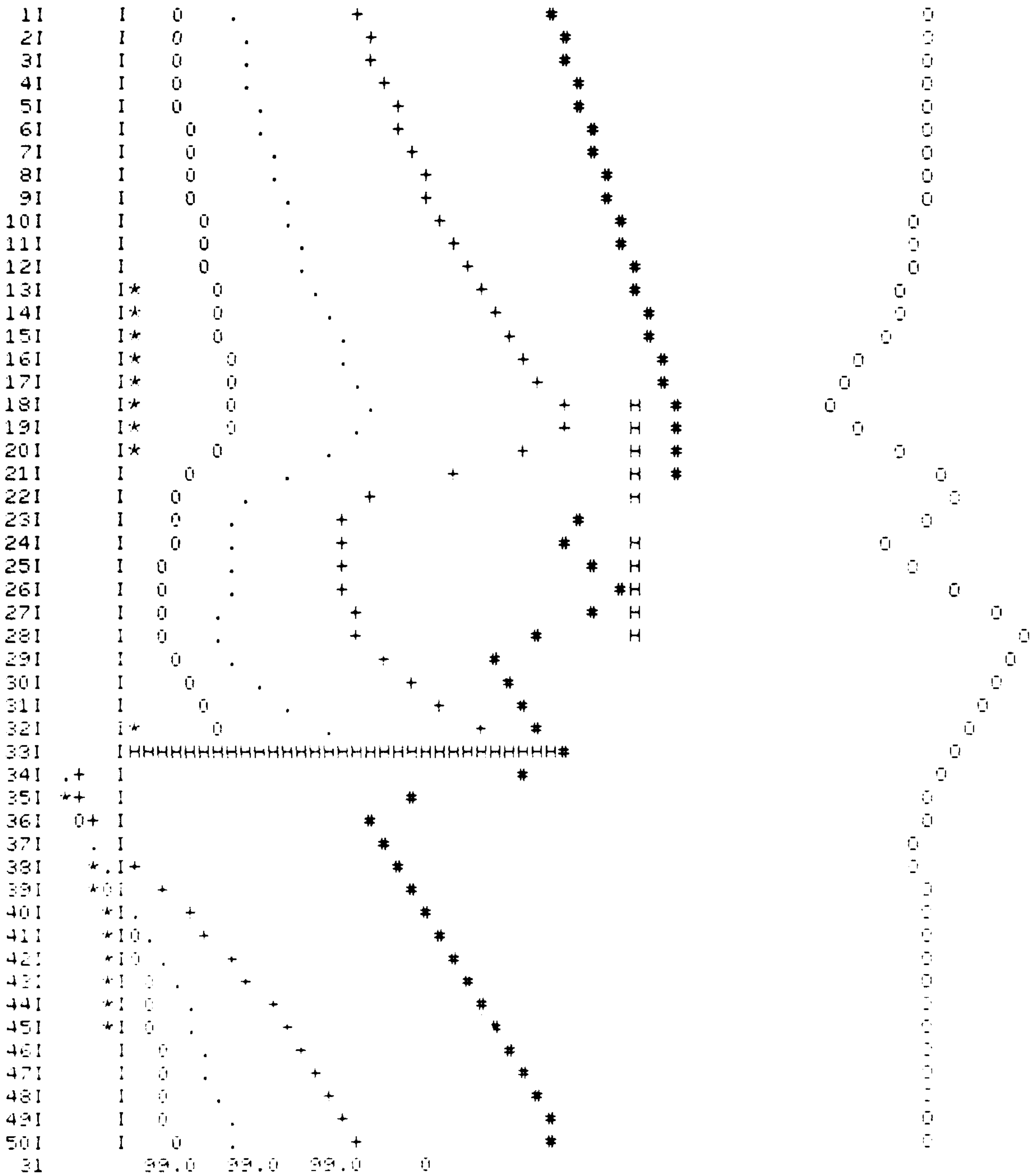
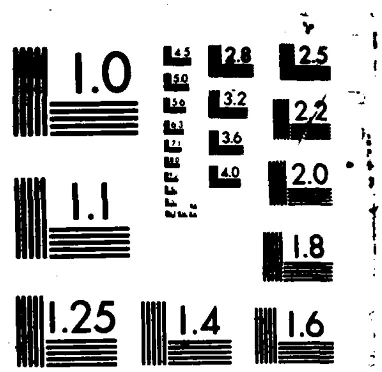


APPENDIX B: PROGRAM LISTING

AD-A185 280 A USER'S GUIDE TO THE N-LINE MODEL: A NUMERICAL MODEL 2/2
TO SIMULATE SEDIMEN..(U) COASTAL ENGINEERING RESEARCH
CENTER VICKSBURG MS N W SCHEFFNER ET AL. AUG 87
UNCLASSIFIED CERC-87-4 F/G 8/8 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

APPENDIX B: PROGRAM LISTING

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      WRITE(2,738)   DIAM
  738 FORMAT(2X,"THE SEDIMENT DIAMETER, DIAM= ",F10.3)
      WRITE(2,732)
  780 FORMAT(2X,"SUPPLY MMAX( THE NO. OF GROINS) AND THEIR I-LOC",/)
      UCRIT=16.3*SQRT(DIAM*0.00328)
C*THE NO. OF MULTIPLE GROINS,MMAX MUST BE GIVEN THEIR X LOCATIONS.
      READ(1,779)   MMAX
  779 FORMAT(I3)
      DO 760 M=1,MMAX
C*IJET REPS LESSER I-VALUE ADJACENT TO STRUCTURE.
      READ(1,778)   IJET(M),SJETTY(M)
  760 WRITE(2,761) SJETTY(M)
  778 FORMAT(I3,F10.3)
      WRITE(2,759)  (M,IJET(M),M=1,MMAX)
  759 FORMAT(2X,"THE NUMBER",I5," GROIN IS LOCATED AT GRID",I5)
      WRITE(2,732)
C*CONVERT TO RADIANS.
C*FIRST MUST GIVE Y COORS POSITIONS AND DEPTHS.
C*FIRST, MUST SET UP ALL OF THE DEEP-VALUES.
C****READ THE VALUE OF ADEAN
      READ(1,774)ADEAN
  774 FORMAT(F10.4)
      WRITE(2,749)   ADEAN
  749 FORMAT(2X,"THE VALUE OF ADEAN= ",F10.4,"  IN THE EQ. H=AY**2/3")
      WRITE(2,732)
      READ(1,775)   DX,DELT
  775 FORMAT(2(F10.3))
      WRITE(2,737)   DX
  737 FORMAT(2X,"THE VALUE OF THE LONGSHORE SPACE-STEP, DX= ",F10.3)
      WRITE(2,736)   DELT
  736 FORMAT(2X,"THE TIME-STEP IN SECONDS, DELT= ",F10.3)
       DO 220 J=1,JMAX+3
      DO 220 I=1,IMAX+1
  220 DEEP(I,J)=CHANGE(J)
      DATA(HC(I),I=1,8)/1.87,0.5,0.35,.25,.21,.20,.19,.19/
      DATA(TC(I),I=1,8)/2.,3.,4.,6.,8.,10.,12.,14./
*************DEFINE INITIAL COASTLINE*******
      READ(1,63) (Y(I,1),I=1,IMAX)
   63 FORMAT(10F8.2)
*********************************************
      DO 200 J=1,JMAX+2
      DO 200 I=1,IMAX
  200 Y(I,J+1)=(0.5*(DEEP(I,J+1)+DEEP(I,J))/ADEAN)**1.5+Y(I,1)
      WRITE(2,732)
      WRITE(2,772)
  772 FORMAT(3X,35HTHE INITIAL SHORELINE COORDINATES :)
      WRITE(2,9993) (Y(I,1),I=1,IMAX)
 9993 FORMAT(10F8.2)
      WRITE(2,732)
C***************************
C*WE WILL ALWAYS REQUIRE Y(I,JM) TO COMPUTE DY AND YBAR.
C*WE WILL ALWAYS REQUIRE DEEP(I,JM) TO COMP SEDIMENT TRANSPORT.
C***************************
      WRITE(2,734)
  734 FORMAT(2X,"THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS",/)
```

```
      WRITE(2,801)   (Y(1,J),J=1,JMAX+2)
      WRITE(2,801)   (Y(IMAX,J),J=1,JMAX+2)
      WRITE(2,732)
      WRITE(2,735)
  735 FORMAT(2X,"THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS",)
      WRITE(2,801)   (DEEP(1,J),J=1,JMAX+2)
      WRITE(2,732)
  801 FORMAT(10F8.2)
      DO 2 I=1,IMAX
  2   YZERO(I)=Y(I,1)-(BERM/SFACE)
C*WILL COMPUTE THE EQUIL WIDTH BETWEEN CONTOURS, HERE.
      DO 1 I=1,IMAX
      WEQ(I,1)=Y(I,1)-YZERO(I)
      DO 1 J=1,JMAX
      IF(J.NE.1)   GO TO 32
      YTEMP1=0.0
      GO TO 33
  32  YTEMP1=((0.5*(DEEP(I,J-1)+DEEP(I,J)))/ADEAN)**1.5
  33  YTEMP2=((0.5*(DEEP(I,J)+DEEP(I,J+1)))/ADEAN)**1.5
      WEQ(I,J+1)=YTEMP2-YTEMP1
   1  CONTINUE
C*LET\S STORE THE ORIG VALUES TO COMPUTE VOL CHANGES OVER CONTOURS,LATER
      DO 796 I=1,IMAX+1
      YZEROO(I)=YZERO(I)
       DO 796 J=1,JMAX+2
  796 YORIG(I,J)=Y(I,J)
C**********************************************************************
C READ IN THE BREAKWATER INFORMATION
C**********************************************************************
      READ(1,800) NOBKS
  800 FORMAT(I5)
      IF(NOBKS.EQ.0) GO TO 899
      DO 805 N=1,NOBKS
  805 READ(1,807) ILFT(N),IRT(N),YLFT(N),YRT(N)
  807 FORMAT(10X,2I10,2F10.2)
      WRITE(2,732)
      WRITE(2,810)
  810 FORMAT(1X,45HBREAKWATER  LEFT LOC  RIGHT LOC  LEFT Y VALUE,2X,
     113HRIGHT Y VALUE)
      DO 820 N=1,NOBKS
  820 WRITE(2,830) N,ILFT(N),IRT(N),YLFT(N),YRT(N)
  830 FORMAT(4X,I3,8X,I3,7X,I3,7X,F9.2,5X,F9.2)
      WRITE(2,732)
  899 CONTINUE
C***********************************************************************
C*READ THE DISK FILE AND TRANSFORM PARAMETERS INTO MY UNITS.
C******************?????????????????????????????????*******************
C*ALL ADJUSTMENTS TO WAVE ANGLE,HEIGHT,CELERITY,GROUP VEL, WILL BE MADE
C**HERE, AND THRUOUT THE REST  OF THE PROG, THEY WILL BE AS IF OCCURRED
C***AT WDEPTH?
C****SELECT DREDGED DISPOSAL OPTION
  798 READ(1,799) IJKLMN,HS,T,ALPWIS,IDDD
      WRITE(2,799) IJKLMN,HS,T,ALPWIS,IDDD
C     IF(EOF(5) .EQ. 1) GO TO 1000
      IF(HS.GT.50.) GO TO 1000
```

```
C***********************************
  799 FORMAT(I5,5X,3F6.1,I5)
      NTIMES=1
      NCHECK=NUNIV+NTIMES
      HGEN=0.707107*HS
      SIGMA=TWOPI/T
      G=32.17
      CO=G*T/TWOPI
      ELO=CO*T
      IF(T.LE.2.0)   GO TO 797
      HCC=0.23
      DO 444 I=2,7
      T2=TC(I)
      IF(T.GT.T2)   GO TO 444
      T1=TC(I-1)
      DELTAT=T2-T1
      DT=(T-T1)/DELTAT
      DTT=(T2-T)/DELT
      HCC=HC(I)*DT+HC(I-1)*DTT
      GO TO 446
  444 CONTINUE
  446 CONTINUE
      IF(HGEN.LT.HCC)   GO TO 797
      ANGGEN=ALPWIS*TWOPI/360.
C**********************************************************************
      CALL WVNUM(WDEPTH,T,DUMKK)
C*ANGGEN,HGEN,CGEN,CGGEN REPRESENT THE WAVE ANGLE,HEIGHT,CELERITY AND
C**GROUP VEL(RESPECT.) OF THE SPECIFIED WAVE INPUT AT A DEPTH, WDEPTH
      CALL WVNUM(11.0,T,DUMKKK)
      C11=TWOPI/(T*DUMKKK)
      CG11=0.5*C11*(1.+(2.*DUMKKK*11.0/SINH(2.*DUMKKK*11.0)))
      CGEN=TWOPI/(T*DUMKK)
      CGGEN=0.5*CGEN*(1.+(2.*DUMKK*WDEPTH/SINH(2.*DUMKK*WDEPTH)))
      IF(IDDD.EQ.0) GO TO 8002
      WRITE(2,67) NCHECK
   67 FORMAT(1X,31HDREDGED MATERIAL ADDED AT TIME ,I5)
      WRITE(2,294) NCHECK
  294 FORMAT(1X,40HCONTOURS AFTER MATERIAL ADDITION AT TIME,I5,4HARE:)
   66 READ(20,65) IDREG,JDREG,DREDGE
   65 FORMAT(2I5,F10.2)
      IF(IDREG.EQ.IMAX.AND.JDREG.EQ.JMAX) GO TO 795
      Y(IDREG,JDREG)=Y(IDREG,JDREG)+DREDGE
      GO TO 66
  795 CONTINUE
      DO 8001 I=1,IMAX
 8001 WRITE(2,8000) I,(Y(I,J),J=1,JMAX)
 8000 FORMAT(I5,8F9.3)
 8002 CONTINUE
      IF(NUNIV.EQ.0) CALL PLOTNS(IMAX,JMAX,Y,YLFT,YRT,ILFT
     1,IRT,SJETTY,IJET,NOBKS,MMAX)
      REWIND 20
      CALL TRANS
  797 IF(NCHECK.NE.NUNIV)  NUNIV=NCHECK
  709 GO TO 798
 1000 CONTINUE
```

```
      STOP
      END
      SUBROUTINE TRANS
      PARAMETER (NI=53,NJ=11)
C**********************************************************************
C*THIS SUBROUTINE WILL COMPUTE SEDIMENT TRANSPORT
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/BB/WEQ(NI,NJ)
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/E/RHO,RHOS,POROS,CONST,TKSI
      COMMON/F/ADEAN,REPOSE,DIAM
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      COMMON/P/HBQ(NI),DEEPB(NI)
      COMMON/ZZZ/NTIME
      COMMON/AAA/DELT,NTIMES
      COMMON/COUNT/NUNIV,NWRITE
      COMMON/NWS/ILFT(5),IRT(5),YLFT(5),YRT(5),NOBKS
     1,DEEPR(5),DEEPL(5),HRT(5),HLFT(5)
      DIMENSION YOLD(NI,NJ),R(NI,NJ),S(NI,NJ),HC(NI,NJ),QY(NI,NJ),YDISS(
     *   60,20)
      DIMENSION RHS1(NI,NJ),S3(NI,NJ),THETAB(NI,NJ),ANGLOC(NI,NJ)
       DIMENSION DISTR(NI,NJ),AWARE(NI,NJ),
     *BMATRX((NJ-3)*(NI-5)),ABAND((NJ-3)*(NI-5),2*(NJ-3)+1),QX(NI,NJ),
     1XL((NJ-3)*(NI-5),NJ-2),CONST6(NI,NJ)
C**********************************************************************
C**********************************************************************
C**************  NOTE   00000SIZE OF ABAND AND XL HAVE TO BE CHANGED
C**************           ACCORDING TO JMAX+1+JMAX AND JMAX+1,RESPECT.
C**************           CHANGE REQ\D AT 7040 AND 18650
C**********************************************************************
      COMMON/MP/ RKB(NI),HBI(NI),DEEPBI(NI)
      COMMON/EXPL/QYEXP(NI,NJ),YIMP(NI,NJ)
      DIMENSION SANGLE(NJ)
      DO 199 J=1,JMAX+3
      SANGLE(J)=0.
      DO 199 I=1,IMAX+3
      YOLD(I,J)=0.
      R(I,J)=0.
      QY(I,J)=0.
      YDISS(I,J)=0.
      RHS1(I,J)=0.
      S3(I,J)=0.
      THETAB(I,J)=0.
      ANGLOC(I,J)=0.
      DISTR(I,J)=0.
      AWARE(I,J)=0.
      QX(I,J)=0.
      CONST6(I,J)=0.
      QYEXP(I,J)=0.
  199 CONTINUE
```

```
      DO 200 I=1,IMAX+3
      DEEPB(I)=0.
      HBQ(I)=0.
      DEEPBI(I)=0.
  200 HBI(I)=0.
      RHO=1.99
      RHOS=5.14
      POROS=0.40
      CONST=0.77
      CAPPA=0.78
      TAU=0.25
      TKSI=(CONST*RHO*SQRT(G))/((RHOS-RHO)*(1.0-POROS)*16.0*SQRT(CAPPA))
C*  QX(I,J) IS THE TRANSPORT BETWEEN THE (I,J+1) AND (I,J) CONTOURS.
C*THE \DO 1 LOOP\ SIMULATES TIME---TIME=DELT*NTIMES.
      COFF=0.00001
      GAMMA=RHO*G
      DO 1 NTIME=1,NTIMES
      NUNIV=NUNIV+1
C*THE MATRICES ABAND AND BMATRX  MUST BE \ZEROED OUT\
      K=0
        DO 26 I=2,IMAX-1
      DO 26 J=1,JMAX
      K=K+1
      BMATRX(K)=0.0
        DO 26 L=1,JMAX+1+JMAX
   26 ABAND(K,L)=0.0
      XNTIME=1.0*(NTIME)
      CALL PREDIF
      IF(NOBKS.EQ.0) GO TO 10
      CALL BRKH2O(IMAX,JMAX,MMAX,Y,THETA,H,C,IJET,SJETTY,T,DX
     1,DEEP,HB,CG)
   10 CONTINUE
C*SMOOTHING OF THE WAVE ANGLE,THETA, IS RE\D TO ACCT FOR DIFF EFFECTS.
      CALL SMOOTH(THETA,IMAX,JMAX,IJET,SJETTY,MMAX,Y)
      CALL QTRAN
      IF(NOBKS.EQ.0) GO TO 9990
      DO 9999 N=1,NOBKS
      XDD=ILFT(N)-IRT(N)
      DO 9998 NN=ILFT(N),IRT(N)-1
      XLT=ILFT(N)-NN+.5
      DEEPDM=DEEPL(N)-(DEEPL(N)-DEEPR(N))*XLT/XDD
      IF(DEEPB(NN+1).GE.DEEPDM) GO TO 9998
      DEEPB(NN+1)=DEEPDM
      HBQ(NN+1)=HLFT(N)-(HLFT(N)-HRT(N))*XLT/XDD
 9998 CONTINUE
      DEEPB(ILFT(N))=.5*(DEEPB(ILFT(N))+DEEPB(ILFT(N)-1))
      HBQ(ILFT(N))=.5*(HBQ(ILFT(N))+HBQ(ILFT(N)-1))
      DEEPB(IRT(N)+1)=.5*(DEEPB(IRT(N))+DEEPB(IRT(N)+1))
      HBQ(IRT(N)+1)=.5*(HBQ(IRT(N))+HBQ(IRT(N)+1))
 9999 CONTINUE
 9990 CONTINUE
C*FIRST THE LONGSHORE SEDIMENT TRANSPORT WILL BE DISTRIBUTED
C****ACROSS THE SURF ZONE....
      CC=1.25
C***QX(I,J) WILL BE DETERMINED BY SUBTRACTING FROM THE INTEGRAL
```

```
C**OF QX FROM DEEP(I,J-1) TO INFINITY, THE INTEGRAL OF QX FROM DEEP(I,J)
C***TO INFINITY. IN THIS WAY THE SEDIMENT TRANS FROM JMAX OUT GETS
C***INCLUDED IN QX(I,JMAX). TO INCLUDE THE SWASH TRANS, WHEN J=1
C*WE WILL SUBTRACT FROM 2 TO INFINITY FROM 1.0
C*LOOP FOR VALUES WHICH ARE HELD CONST AND STORED.
      THETAB(1,1)=0.5*(THETA(1,1)+0.0)
      R(1,1)=0.5/(DX*(DEEP(1,1)+BERM/2.))
      DO 290 I=2,IMAX
      R(I,1)=0.5/(DX*(DEEP(I,1)+BERM/2.))
C*    THETAB(I,1)=0.25*(THETA(I,1)+THETA(I-1,1)+0.+0.)
      THETAB(I,1)=0.5*(THETA(I,1)+THETA(I-1,1))
C*NO NEED TO COMPUTE PROP ANGLE AT STRUCTS BECAUSE QX =0.0 AT IJET(M)+1
      ANGLOC(I,1)=ATAN((Y(I,1)-Y(I-1,1))/DX)
C*HBQ(IJET(M)+1) IS PROPERLY SET IN THE SUBROUTINE QTRAN.
      ARG0=((DEEP(I,1)**1.5+HBQ(I)*ADEAN**1.5)/(CC*DEEPB(I)**1.5
     1))**3
      IF(ARG0.GT.50.) ARG0=50.
      DISTR(I,1)=1.0-EXP(-ARG0)
      DISTR(I,1)=DISTR(I,1)*TKSI*HBQ(I)**2.5
      DO 290 J=2,JMAX
      R(I,J)=0.5/(DX*(DEEP(I,J)-DEEP(I,J-1)))
      THETAB(I,J)=0.5*(THETA(I,J)+THETA(I-1,J))
      ANGLOC(I,J)=ATAN((Y(I,J)-Y(I-1,J))/DX)
      ARG1=((DEEP(I,J-1)**1.5+HBQ(I)*ADEAN**1.5)/(CC*DEEPB(I)**1.5
     1))**3
      ARG2=((DEEP(I,J)**1.5+HBQ(I)*ADEAN**1.5)/(CC*DEEPB(I)**1.5
     1))**3
      IF(ARG1.GT.50.) ARG1=50.
      IF(ARG2.GT.50.) ARG2=50.
      DISTR(I,J)=EXP(-ARG1)-EXP(-ARG2)
      DISTR(I,J)=DISTR(I,J)*TKSI*HBQ(I)**2.5
  290 CONTINUE
      DO 301 J=1,JMAX
      DO 301 I=2,IMAX
      AWARE(I,J)=DELT*R(I,J)*(QX(I,J)-QX(I+1,J)+QY(I,J)-QY(I,J+1))+Y(I,J
     *   )
      S1=2.*SIN(THETAB(I,J))*COS(THETAB(I,J))*(-1.+2.*(COS(
     *   ANGLOC(I,J)))**2)
      S2=COS(2.*THETAB(I,J))*COS(ANGLOC(I,J))/(SQRT(DX**2+
     *   (Y(I,J)-Y(I-1,J))**2))
      S3(I,J)=S2*DISTR(I,J)
      DO 325 M=1,MMAX
      IF(SJETTY(M).EQ.0.0) GO TO 302
      IF(I.NE.IJET(M)+1)   GO TO 325
      IF(THETAO(M).GE.0.0)   ISIDE=IJET(M)
       IF(THETAO(M).LT.0.0)  ISIDE=IJET(M)+1
      YSEA=0.5*(Y(ISIDE,J)+Y(ISIDE,J+1))
      IF(J.EQ.1) DUMYY=YZERO(ISIDE)
      IF(J.GT.1) DUMYY=Y(ISIDE,J-1)
      YSHORE=0.5*(Y(ISIDE,J)+DUMYY)
      IF(YSEA.GT.SJETTY(M).AND.YSHORE.GT.SJETTY(M))    GO TO 302
      IF(YSEA.GT.SJETTY(M).AND.YSHORE.LE.SJETTY(M))    GO TO 298
C*BECAUSE A NO FLOW B.C. IS USED ALONG THE STRUCT, NO ATTN WAS PAID
C**TO GETTING PROPER VALUES OF ANGLOC, THETAB,DISTR,ETC.
      S3(I,J)=0.0
```

```
      DISTR(I,J)=0.0
      GO TO 302
  325 CONTINUE
      GO TO 302
C***ABOVE, ALL PARAMETERS(I.E.,S1,S2,S3,THETAB,DISTR,ANGLOC)
C***ARE COMPUTED AS IF THE STRUCT IS NOT THERE. THE B.C. AT THE
C***STRUCT TIP ASSUMES QX COMPUTED AS IF NO STRUCT PRESENT AND THEN
C***BYPASSES ACCORDING TO \RATIO\.
  298 RATIO=(YSEA-SJETTY(M))/(YSEA-YSHORE)
      S3(I,J)=S3(I,J)*RATIO
      DISTR(I,J)=DISTR(I,J)*RATIO
  302 RHS1(I,J)=DISTR(I,J)*S1-S3(I,J)*(Y(I,J)-Y(I-1,J))
 301  CONTINUE
      CALL BREAK(IMAX,JMAX)
      IF(NOBKS.EQ.0) GO TO 9991
      DO 9996 N=1,NOBKS
      XDD=ILFT(N)-IRT(N)
      DO 9996 NN=ILFT(N),IRT(N)
      XLT=ILFT(N)-NN
      DEEPDM=DEEPL(N)-(DEEPL(N)-DEEPR(N))*XLT/XDD
      IF(DEEPBI(NN).GE.DEEPDM) GO TO 9996
      DEEPBI(NN)=DEEPDM
      HBI(NN)=HLFT(N)-(HLFT(N)-HRT(N))*XLT/XDD
 9996 CONTINUE
 9991 CONTINUE
C*TO DETERMINE DECAY OF CONST6(I,J),NEED WAVE NO. AT BREAKING.
        DO 754 I=1,IMAX+1
  754 CALL WVNUM(DEEPBI(I),T,RKB(I))
C*USING SHIELD\S DIAG,Y AXIS=0.05 + (TAUO=RHO*C*U**2),GET UCRIT(FT/SEC)
      UCRIT=16.3*SQRT(DIAM*.00328)
      DO 748 J=1,JMAX+2
  748 H(IMAX+1,J)=H(IMAX,J)
      DO 750 I=1,IMAX+1
      CONST6(I,1)=COFF*DX
        DO 750 J=2,JMAX+2
C*CONST6(I,J) GOES W/ QY(I,J) WHICH IS ASSOC W/ DEEP(I,J-1)
      IF(DEEP(I,J-1).LE.DEEPBI(I))   GO TO 751
C*HERE, MUST CAUSE COFF TO DECAY (WE\RE BEYOND SURF ZONE)
      UMAXB=HBI(I)*G*T*RKB(I)/(2.*TWOPI*COSH(RKB(I)*DEEPBI(I)))
      UMAX=H(I,J-1)*G*T*RK(I,J-1)/(2.*TWOPI*COSH(RK(I,J-1)*DEEP(I,J-1)))
      IF(UCRIT.LT.UMAX.AND.UCRIT.LT.UMAXB)   GO TO 749
      CONST6(I,J)=0.0
      GO TO 750
  749 TOP=0.01*H(I,J-1)**3*SIGMA**3/(SINH(RK(I,J-1)*DEEP(I,J-1))**3)
      BOT=DEEP(I,J-1)*(0.625*TWOPI*G**1.5*0.78**2*ADEAN**1.5+
     *(0.01*HBI(I)**3*SIGMA**3/(DEEPBI(I)*(SINH(RKB(I)*DEEPBI(I)))**3)))
      CONST6(I,J)=DX*COFF*TOP/BOT
      GO TO 750
  751 CONST6(I,J)=COFF*DX
  750 CONTINUE
      K=0
C**PUT INTO BANDED FORM USING THE ALGORITHM  A(M,N)-;B(M,NN) WHERE
C***NN=KB+1-M+N(KB IS THE NUMBER OF LOWER CODIAGONALS(=JMAX,HERE)).
        DO 304 I=2,IMAX-1
      DO 304 J=1,JMAX
```

```
      K=K+1
      AWARE(I,J)=AWARE(I,J)+DELT*RHS1(I,J)*R(I,J)-DELT*R(I,J)*RHS1(I+1,J
     *   )+DELT*R(I,J)*CONST6(I,J)*WEQ(I,J)-DELT*R(I,J)*CONST6(I,J+1)*
     *   WEQ(I,J+1)
      YDUM=YZERO(I)
      IF(J.NE.1)   YDUM=Y(I,J-1)
      AWARE(I,J)=AWARE(I,J)+DELT*R(I,J)*CONST6(I,J)*0.5*(YDUM-Y(I,J))
     *   -DELT*R(I,J)*CONST6(I,J+1)*0.5*(Y(I,J)-Y(I,J+1))
      U=DELT*R(I,J)*S3(I,J)
      V=DELT*R(I,J)*S3(I+1,J)
      Z1=DELT*R(I,J)*CONST6(I,J)*0.5
      Z2=DELT*R(I,J)*CONST6(I,J+1)*0.5
C*NOW WILL SET UP THE MATRICES ABAND AND BMATRX.
      ABAND(K,JMAX+1)=1.0+U+V+Z1+Z2
      IF(I.NE.2)   GO TO 305
      AWARE(I,J)=AWARE(I,J)+U*Y(I-1,J)
      GO TO 310
  305 ABAND(K,1)=-U
  310 IF(I.NE.IMAX-1)   GO TO 306
      AWARE(I,J)=AWARE(I,J)+V*Y(IMAX,J)
      GO TO 311
  306 ABAND(K,JMAX+1+JMAX)=-V
  311 IF(J.NE.1)   GO TO 307
      ABAND(K,JMAX+1)=ABAND(K,JMAX+1)-Z1
      AWARE(I,1)=AWARE(I,1)+Z1*(YZERO(I)-Y(I,1))
      GO TO 312
  307 ABAND(K,JMAX)=-Z1
  312 IF(J.NE.JMAX)   GO TO 308
      AWARE(I,J)=AWARE(I,J)+Z2*Y(I,JMAX+1)
      GO TO 309
  308 ABAND(K,JMAX+2)=-Z2
  309 BMATRX(K)=AWARE(I,J)
  304 CONTINUE
      KMAX=K
C**CALL IMSL ROUTINE LEQT1B TO SOLVE THE BANDED MATRIX.
      ISIZE=(NJ-3)*(NI-5)
      CALL LEQT1B(ABAND,KMAX,JMAX,JMAX,ISIZE,BMATRX,1,ISIZE,0,XL,IER)
C*NOW, GIVE Y\S THEIR NEW VALUES STORING OLD VALUES IN YOLD.
      K=0
        DO 315 I=2,IMAX-1
      YOLD(I,JMAX+1)=Y(I,JMAX+1)
      DO 315 J= 1,JMAX
      K=K+1
      YOLD(I,J)=Y(I,J)
      Y(I,J)=BMATRX(K)
  315 CONTINUE
      DO 320 J=1,JMAX+3
      YOLD(1,J)=Y(1,J)
  320 YOLD(IMAX,J)=Y(IMAX,J)
C*WILL USE ABBOTT\S DISSIPATIVE INTERFACE TO RID HIGH FREQ OSCILLATIONS
      DO 650 J=1,JMAX
      DO 650 I=2,IMAX-1
      YDISS(I,J)=TAU*Y(I-1,J)+(1.-2.*TAU)*Y(I,J)+TAU*Y(I+1,J)
      DO 649 M=1,MMAX
      IF(SJETTY(M).EQ.0.) GO TO 650
```

```
      IF(I.NE.IJET(M).AND.I.NE.IJET(M)+1)   GO TO 649
      IF(Y(IJET(M),J).GT.SJETTY(M).OR.Y(IJET(M)+1,J).GT.SJETTY(M))GO
     1 TO 649
      IF(I.EQ.IJET(M))YDISS(I,J)=TAU*Y(I-1,J)+(1.-TAU)*Y(I,J)
      IF(I.EQ.(IJET(M)+1))YDISS(I,J)=TAU*Y(I+1,J)+(1.-TAU)*Y(I,J)


  649 CONTINUE
  650 CONTINUE
      DO 651 J=1,JMAX
      DO 651 I=2,IMAX-1
  651 Y(I,J)=YDISS(I,J)
C*THIS LOOP WILL STORE THE IMPLICIT Y VALUES REQ\D TO COMP QY+QX
      DO 40 I=1,IMAX+1
      DO 40 J=1,JMAX+3
   40 YIMP(I,J)=Y(I,J)
C*THIS LOOP WILL EXPLICITLY MOVE CONTOURS SEAWARD IF REPOSE EXCEEDED.
      KOUNT=0
      SLOPEM=TAN(0.9*REPOSE)
      DO 48 I=1,IMAX
   43 KOUNT=KOUNT+1
      IF(KOUNT.GT.50000)   GO TO 41
C*LET US COMPUTE ALL THE SLOPES(PSLOP) FOR EACH CHANGE IN DEPTH.
      DO 47 J=1,JMAX+1
      DUM=-BERM/2.0
      IF(J.NE.1)   DUM=DEEP(I,J-1)
      DELH=0.5*(DEEP(I,J+1)+DEEP(I,J))-0.5*(DEEP(I,J)+DUM)
      PSLOP=DELH/(Y(I,J+1)-Y(I,J))
   47 SANGLE(J)=ATAN(PSLOP)
C*FIND THE MIN NEG SLOPE ANGLE OR THEN THE POS SLOPE;REPOSE OR FORGET IT
      ASLOPM=-1.0E50
      ASLOPP=0.0
      DO 46 J=1,JMAX+1
      IF(SANGLE(J).GT.0.0)   GO TO 45
      IF(SANGLE(J).GT.ASLOPM)ASLOPM=SANGLE(J)
      IF(ASLOPM.EQ.SANGLE(J))   JM=J
      GO TO 46
   45 IF(SANGLE(J).GT.REPOSE.AND.SANGLE(J).GT.ASLOPP)ASLOPP=SANGLE(J)
      IF(ASLOPP.EQ.SANGLE(J))   JP=J
   46 CONTINUE
      IF(ASLOPM.EQ.-1.0E50.AND.ASLOPP.EQ.0.0)   GO TO 42
      IF(ASLOPM.EQ.-1.0E50)   GO TO 44
      DUM=-BERM/2.
      IF(JM.NE.1)   DUM=DEEP(I,JM-1)
      ALTER=((0.5/SLOPEM*(DEEP(I,JM+1)-DUM))-(Y(I,JM+1)-Y(I,JM)))/
     *   (1.0+((DEEP(I,JM+1)-DEEP(I,JM))/(DEEP(I,JM)-DUM)))
      Y(I,JM+1)=Y(I,JM+1)+ALTER
      Y(I,JM)=Y(I,JM)-(ALTER*(DEEP(I,JM+1)-DEEP(I,JM))/(DEEP(I,JM)-DUM))
      QYEXP(I,JM+1)=QYEXP(I,JM+1)+DX/DELT*ALTER*(DEEP(I,JM+1)-DEEP(I,JM)
     *   )
      GO TO 43
   44 CONTINUE
      DUM=-BERM/2.
      IF(JP.NE.1)   DUM=DEEP(I,JP-1)
      ALTER=((0.5/SLOPEM*(DEEP(I,JP+1)-DUM))-(Y(I,JP+1)-Y(I,JP)))/
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```
     *   (1.0+((DEEP(I,JP+1)-DEEP(I,JP))/(DEEP(I,JP)-DUM)))
      Y(I,JP+1)=Y(I,JP+1)+ALTER
      Y(I,JP)=Y(I,JP)-(ALTER*(DEEP(I,JP+1)-DEEP(I,JP))/(DEEP(I,JP)-DUM))
      QYEXP(I,JP+1)=QYEXP(I,JP+1)+DX/DELT*ALTER*(DEEP(I,JP+1)-DEEP(I,JP)
     *   )
      GO TO 43
   42 WEQ(I,JMAX+1)=Y(I,JMAX+1)-Y(I,JMAX)
   48 CONTINUE
C*IF WE GET SENT HERE, LOOP 444 WILL CATCH THE CROSSED CONTOURS.
   41 CONTINUE
C*NOW WE CAN COMPUTE QX\S AND QY\S?
      DO 318 I=2,IMAX
C*ALL IMPLIC AND EXPLIC MOVEMENT OF YZERO WILL BE TAKEN CARE OF HERE
      BRF=.5
      QY(I,1)=-BRF*BERM*DX*(Y(I,1)-YOLD(I,1))/DELT
      YZERO(I)=YZERO(I)+BRF*(Y(I,1)-YOLD(I,1))
  319 DO 318 J=1,JMAX
      QX(I,J)=RHS1(I,J)-S3(I,J)*YIMP(I,J)+S3(I,J)*YIMP(I-1,J)
  318 QY(I,J+1)=CONST6(I,J+1)*(0.5*(YIMP(I,J)+YOLD(I,J)-YIMP(I,J+1)
     *   -YOLD(I,J+1))+WEQ(I,J+1))
      DO 323 J=1,JMAX
      QX(1,J)=QX(2,J)
  323 QX(IMAX+1,J)=QX(IMAX,J)
C*TOTAL QYS WILL BE COMP FROM IMPLIC AND EXPLIC VALUES.THEN ZERO QYEXP
      DO 39 I=1,IMAX+1
      DO 39 J=1,JMAX+3
       QY(I,J)=QY(I,J)+QYEXP(I,J)
   39 QYEXP(I,J)=0.0
C*THIS CHECK WILL BOMB THINGS OUT IF CONTOURS HAVE CROSSED.
      DO 444 I=1,IMAX
      DO 444 J=1,JMAX
C*IF CONTOURS CROSS AT ANY TIME WANT PROGRAM TO STOP?
      IF(Y(I,J).LT.Y(I,J+1))   GO TO 444
      WRITE(2,103)
 9265 FORMAT(" */ REPLACEMENT ",I5)
       WRITE(2,9265) NUNIV
COMMENT WRITE(2,*/) NUNIV
  103 FORMAT(2X,"THE CONTOURS HAVE CROSSED AND SOMETHING IS WRONG",/)
COMMENT I AND J HAVE BEEN CHANGED TO II AND JJ HERE
      DO 150 JJ=1,JMAX
  150   WRITE(2,100)   (QX(II,JJ),II=1,IMAX)
      DO 151 JJ=1,JMAX
  151   WRITE(2,101)   (QY(II,JJ),II=1,IMAX)
      DO 152 JJ=1,JMAX
  152   WRITE(2,100)   (Y(II,JJ),II=1,IMAX)
      DO 19 JJ=1,JMAX
   19 WRITE(2,100) (YOLD(II,JJ),II=1,IMAX)
COMMENT I AND J WERE CHANGED DOWN TO HERE
      GO TO 445
  444 CONTINUE
C     WRITE(2,9265) NUNIV
COMMENT WRITE(2,9265) NUNIV
C*THE FOLLOWING STATEMENT DETERMINES AT WHAT FREQ EVERYTHING IS WRITTEN?
      IF(MOD(NUNIV,NWRITE).NE.0)   GO TO 1
C*LET\S WRITE ALL OF IT OUT.
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```
      WRITE(2,926)   NUNIV
  926 FORMAT(2X,"THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV= ",I5,/)
 800  FORMAT(2X,14(F8.4))
C*     DO 900 I=1,IMAX
C*900  WRITE(2,800)   (THETA(I,J),J=1,JMAX)
C*     DO 903 J=1,JMAX+1
C*903  WRITE(2,801)   DEEP(1,J)
C*     DO 906 I=1,IMAX
C*906  WRITE(2,800)   (H(I,J),J=1,JMAX)
C*    DO 755 J=1,JMAX
C*755 WRITE(2,800) (CONST6(I,J),I=1,IMAX)
 801  FORMAT(2X,14(F8.2))
C     WRITE(2,107)
C 107 FORMAT(/,2X,"THE LONGSHORE TRANSPORTS,QX, FOLLOW")
C     DO 15 J=1,JMAX
C 15   WRITE(2,100)   (QX(I,J),I=1,IMAX)
C     WRITE(2,108)
C 108 FORMAT(/,2X,"THE ON-OFFSHORE TRANSPORTS, QY, FOLLOW")
C     DO 17 J=1,JMAX
C 17   WRITE(2,101)   (QY(I,J),I=1,IMAX)
C     WRITE(2,109)
C 109 FORMAT(/,2X,"THE NEW CONTOUR VALUES, Y, FOLLOW")
C     DO 18 J=1,JMAX
C 18   WRITE(2,100)   (Y(I,J),I=1,IMAX)
      DO 15 I=1,IMAX
      WRITE(2,17) I
      WRITE(2,1801) (H(I,J),J=1,JMAX+1)
 1801 FORMAT(1X,5HH    ,9F8.3)
      WRITE(2,1802) (THETA(I,J),J=1,JMAX+1)
 1802 FORMAT(1X,5HTHETA,9F8.3)
      WRITE(2,1803) (Y(I,J),J=1,JMAX+1)
 1803 FORMAT(1X,5HY    ,9F8.2)
      WRITE(2,1804) (QX(I,J),J=1,JMAX+1)
 1804 FORMAT(1X,5HQX   ,9F8.3)
   15 WRITE(2,1805) (QY(I,J),J=1,JMAX+1)
 1805 FORMAT(1X,5HQY   ,9F8.3)
   17 FORMAT(1X,17HLONGSHORE STATION,I5)
  100  FORMAT(2X,13(F9.3))
  101 FORMAT(2X,13(F9.4))
      CALL PLOTNS(IMAX,JMAX,Y,YLFT,YRT,ILFT,IRT,SJETTY,IJET,NOBKS,MMAX)
  1   CONTINUE
      RETURN
  445 STOP
  446 CONTINUE
      END
      SUBROUTINE QTRAN
      PARAMETER (NI=53,NJ=11)
C*THIS SUBROUTINE CALCS THE BREAKER HEIGHT  FOR EACH
C***********************************************************************
C*OF THE I GRID LINES. METHOD--FINDS Y-LOCATIONS BEFORE AND AFTER
C*BREAKING HAS OCCURRED BY \REFRAC\, THEN USES SHOALING TO GET THE
C*HBO.SNELL\S LAW IS USED FOR REFRACTION OVER THE SHORT DIST TO BREAKING
C* QX(I,J) IS THE TRANS BETWEEN(I-1,J) AND (I,J) AT THE BLOCKCENT
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
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      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      COMMON/E/RHO,RHOS,POROS,CONST,TKSI
      COMMON/P/HBQ(NI),DEEPB(NI)
      CAPPA=0.78
      DO 1 I=2,IMAX
      DO 2 JJ=1,JMAX
      J=JMAX-JJ+1
      HDUM=(H(I,J)+H(I-1,J))*0.5
      HBDUM=(HB(I,J)+HB(I-1,J))*0.5
C*CAN ONLY USE COND ON ONE SIDE OF STRUCT. CAN\T AVG HERE?
      DO 4 M=1,MMAX
      IF(SJETTY(M).EQ.0.) GO TO 74
      IF(I.NE.IJET(M)+1)   GO TO 4
      IF(THETAO(M).GE.0.0)   ISIDE=IJET(M)
      IF(THETAO(M).LT.0.0)   ISIDE=IJET(M)+1
      YSEA=.5*(Y(ISIDE,J)+Y(ISIDE,J+1))
      IF(YSEA.GT.SJETTY(M))   GO TO 3
      HDUM=H(ISIDE,J)
      HBDUM=HB(ISIDE,J)
      GO TO 3
    4 CONTINUE
   74 CONTINUE
    3 IF(HDUM.LT.HBDUM)   GO TO 2
      DEEPB(I)=((0.5*(H(I,J+1)+H(I-1,J+1)))*(0.5*(DEEP(I,J+1)
     *   +DEEP(I-1,J+1)))**0.25)/CAPPA)**0.8
      HBQ(I)=CAPPA*DEEPB(I)
C*HBQ(I) AND DEEPB(I) WILL BE COMPUTED ACCORDING TO THE WAVE DIR.
C** AT THE STRUCTURE TIP,THETAO.
      DO 6 M=1,MMAX
      IF(SJETTY(M).EQ.0.) GO TO 1
      IF(I.NE.IJET(M)+1)   GO TO 6
C**THE TRANSPORTING WAVES WILL BE COMPUTED USING THE WAVE TO PROP SIDE.
      IF(THETAO(M).GE.0.0)   GO TO 11
      DEEPB(I)=(H(IJET(M)+1,J+1)*DEEP(IJET(M)+1,J+1)**0.25/CAPPA)**0.8
      IBREAK(I)=IBREAK(IJET(M)+1)
      GO TO 12
   11 DEEPB(I)=(H(IJET(M),J+1)*DEEP(IJET(M),J+1)**0.25/CAPPA)**0.8
      IBREAK(I)=IBREAK(IJET(M))
   12 HBQ(I)=DEEPB(I)*CAPPA
      GO TO 1
    6 CONTINUE
      GO TO 1
    2 CONTINUE
    1 CONTINUE
C*IF THE OFFSHORE WAVE HT IS ZERO, NEVER GET TO HERE.
C*HOWEVER IF THE H IS SUCH THAT IT WOULD BREAK INSHORE OF Y(I,2)
      DO 20 I=2,IMAX
      IF(DEEPB(I).GT.0.0)   GO TO 20
      DEEPB(I)=(H(I,1)*DEEP(I,1)**0.25/CAPPA)**0.8
      HBQ(I)=CAPPA*DEEPB(I)
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   20 CONTINUE
      HBQ(1)=HBQ(2)
      HBQ(IMAX+1)=HBQ(IMAX)
      DEEPB(1)=DEEPB(2)
      DEEPB(IMAX+1)=DEEPB(IMAX)
      RETURN
      END
      SUBROUTINE BREAK(IMAX,JMAX)
      PARAMETER(NI=53,NJ=11)
C***********************************************************************
C*ROUTINE WILL DETERMINE HB AND DEEPB ON THE GRID LINES RATHER
C*  THAN BETWEEN THEM. REQ\D FOR COFF BEYOND SURF ZONE.
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/MP/ RKB(NI),HBI(NI),DEEPBI(NI)
      CAPPA=0.78
      DO 1 I=2,IMAX
      DO 2 JJ=1,JMAX
      J=JMAX-JJ+1
      IF(H(I,J).LT.HB(I,J))   GO TO 2
      DEEPBI(I)=((H(I,J+1)*DEEP(I,J+1)**0.25)/CAPPA)**0.8
      HBI(I)=CAPPA*DEEPBI(I)
C***ONCE THE HEIGHT + DEPTH AT BREAKING ARE FOUND, GO TO NEXT GRID-LINE.
      GO TO 1
  2   CONTINUE
  1   CONTINUE
      DO 20 I=2,IMAX
      IF(DEEPBI(I).GT.0.0)   GO TO 20
      DEEPBI(I)=(H(I,1)*DEEP(I,1)**0.25/CAPPA)**0.8
      HBI(I)=CAPPA*DEEPBI(I)
   20 CONTINUE
      DEEPBI(1)=DEEPBI(2)
      DEEPBI(IMAX+1)=DEEPBI(IMAX)
      HBI(1)=HBI(2)
      HBI(IMAX+1)=HBI(IMAX)
      RETURN
      END
      SUBROUTINE REFRAC(JBEGIN,JEND,NPTS,IBEGIN,IEND,ISTART,M)
      PARAMETER(NI=53,NJ=11)
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      COMMON/ZZZ/NTIME
      DIMENSION JBEGIN(NI),JEND(NI)
C****************                              THIS SUBROUTINE WILL DETERMINE H AND
C****************                              THETA AT THE MID PT OF Y VALUES.
C***TAU IS THE FACTOR WHICH RECOUPLES THE REFRACTION EQS.SEE ABBOTT
      TAU=0.25
C*MUST PRESCRIBE THE WAVE ANGLE AT THE OUTERMOSTCONTOUR BOX
C*SNELL\S LAW WILL BE USED TO START THINGS OFF.
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C*THETA(I,J) WILL BE AT AREA\S CENTER AND WILL USE Y(I,J) IN NEG Y-DIR
C*WILL INITIALIZE ALL THETA\S USING SNELL\S LAW.
      DO 206 I=IBEGIN,IEND
C*INITIALIZE TWO J-VALUES BEYOND JMAX,IF IN REGION 1.
      IF(JEND(I).EQ.JMAX)   JINIT=2
      IF(JEND(I).NE.JMAX)   JINIT=0
      DO 206 J= JBEGIN(I),JEND(I)+JINIT
C*MUST CORRECT FOR THE CONTOUR ORIENTATION, ALPHAS.
      IF(I.NE.IBEGIN)   GO TO 960
      ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*(Y(I,J)
     *  +Y(I,J+1)))/DX)
      GO TO 962
  960 IF(I.NE.IEND)   GO TO 961
      ALPHAS(I,J)=ATAN((0.5*(Y(I,J)+Y(I,J+1))-0.5*(Y(I-1,J)
     *  +Y(I-1,J+1)))/DX)
      GO TO 962
  961 ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *  (Y(I-1,J)+Y(I-1,J+1)))/(2.*DX))
  962 DALPHA=ANGGEN-ALPHAS(I,J)
      ARG=(C(I,J )/CGEN)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(I,J)=ASIN(ARG)
C*MUST GET THETA WRT THE X-AXIS.
      THETA(I,J)=THETA(I,J)+ALPHAS(I,J)
  206 CONTINUE
C*NOW, WE MUST COMP THE BOUN WAVE HTS SO THE HTS CAN BE COMPUTED.
C*WILL USE THE EQ. ******   DEL DOT   (E*CG)=0.0
C*NOW WE WILL CORRECT THE HT FOR SHOALING AND REFRACTION TO THE B.C.
C*WILL ALSO INITIALIZE H\S WITH THESE EQUATIONS FOR ENTIRE ARRAY.
      DO 500 I=IBEGIN,IEND
C*INITIALIZE TWO J-VALUES BEYOND JMAX IF IN REGION 1.
      IF(JEND(I).EQ.JMAX)   JINIT=2
      IF(JEND(I).NE.JMAX)   JINIT=0
      DO 500 J=JBEGIN(I),JEND(I)+JINIT
      H(I,J)=HGEN*SQRT(CGGEN/CG(I,J))*SQRT(COS(ANGGEN)/COS(THETA(I,
     *  J)))
      IF(HB(I,J).LT.H(I,J))   H(I,J)=HB(I,J)
 500  CONTINUE
C*-------------------------------------------------------------------
C*******************************************************************
C*LET\S FILL THE DY ARRAY.
C*DY WILL BE INDEXED AS THE THETA TO WHICH WE ARE GOING.
      DO 209 I=IBEGIN,IEND
      DO 209 J=JBEGIN(I)+1,JEND(I)
      DY(I,J-1)=0.5*(Y(I,J-1)+Y(I,J))-0.5*(Y(I,J)+Y(I,J+1))
 209  CONTINUE
      NITERS=100
      DO 100 NITER=1,NITERS
      SUMANG=0.0
C*DO \60 LOOP\ GOES FROM 2 TO IMAX IF ISTART =IBEGIN
C*DO \60 LOOP\  GOES FROM IMAX-1 TO 1 IF ISTART=IEND
      DO 60 II=IBEGIN,IEND
CMUST HAVE IT SET UP SO THAT THE KNOWN BOUNDARIES
        IF(ISTART .EQ. IBEGIN) I=II
COMMENT LINE WITH UNKNOWN CHARACTERS REMOVED HERE.
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      IF(ISTART.EQ.IBEGIN  .AND.  I.EQ.IBEGIN)   GO TO 60
      IF(ISTART.EQ.IEND)   I=IEND-II+IBEGIN
      IF(ISTART.EQ.IEND  .AND.  I.EQ.IEND)   GO TO 60
C*ADX EQUALS ACTUAL DELTA X ACROSS SPACE STEP.
C*ONLY ON BOUNDARIES WHERE FORWARD OR BACKWARD DIFFERENCING.
      IF(I.NE.IBEGIN)   GO TO 6
      ADX=DX
      IP=I+1
      IM=I
      GO TO 12
 6    IF(I.NE.IEND)   GO TO 10
      ADX=DX
      IP=I
      IM=I-1
      GO TO 12
 10   ADX=2.0*DX
      IP=I+1
      IM=I-1
 12    CONTINUE
      DO 40 J=JBEGIN(I),JEND(I)-1
C*WILL GO FROM (JMAX-1) TO 1 BECAUSE THAT\S THE DIR WAVE COMES IN FROM.
      JJ=JEND(I)-1-J+JBEGIN(I)
      OLDANG(I,JJ)=THETA(I,JJ)
C*LOCATE MIDPOINT BETWEEN TWO ADJACENT BLOCK CENTERS
C*BECAUSE THETA\S JJ-VALUE IS THE SAME AS THE FIRST SHOREWARD Y VALUE
C*MUST USE JJ, JJ+1, AND JJ+2 TO COMPUTE YBAR.
      YBAR=0.25*(Y(I,JJ)+2.0*Y(I,JJ+1)+Y(I,JJ+2))
C*LOCATE APPROPRIATE INDICES ON IP AND IM GRID LINES.
      IMINUS=-1
      IPLUS=+1
      CALL LOC(IM,JJ,JOIM,JSIM,YBAR,IMINUS)
      CALL LOC(IP,JJ,JOIP,JSIP,YBAR,IPLUS)
C*NOW USE THE CONSERVATION OF WAVES EQUATION.............
      PART1C=RK(I,JJ+1)*SIN(THETA(I,JJ+1))
      PART2=-DY(I,JJ)/ADX
C*WILL LINEARLY INTERPOLATE TO DETERMINE RK*COS(THETA) AT I+1 AND I-1.
C*IF NO ADJ SHOREWARD PT EXISTS, PUT IN ZERO FOR TERMS IN GOV. EQ.
      IF(JSIM.NE.0)   GO TO 301
      PART3B=0.0
      GO TO 302
  301 TOPIM=RK(IM,JOIM-1)*COS(THETA(IM,JOIM-1))
      BOTIM=RK(IM,JSIM)*COS(THETA(IM,JSIM))
      TOTALB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-0.5*(Y(IM,JSIM+1)+Y(IM,JSIM))
      DUMB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-YBAR
      PART3B=((TOTALB-DUMB)*(TOPIM-BOTIM)/TOTALB)+BOTIM
  302 IF(JSIP.NE.0)   GO TO 303
      PART3A=0.0
      GO TO 304
  303 TOPIP=RK(IP,JOIP-1)*COS(THETA(IP,JOIP-1))
      BOTIP=RK(IP,JSIP)*COS(THETA(IP,JSIP))
      TOTALA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-0.5*(Y(IP,JSIP+1)+Y(IP,JSIP))
      DUMA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-YBAR
      PART3A=((TOTALA-DUMA)*(TOPIP-BOTIP)/TOTALA)+BOTIP
  304 PART3=PART3A-PART3B
C*NOW MUST FIND RK*SIN(THETA) FOR I+1 AND I-1 AT J+1
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      YBARP=0.25*(Y(I,JJ+1)+2.*Y(I,JJ+2)+Y(I,JJ+3))
      CALL LOC(IM,JJ+1,JPOIM,JPSIM,YBARP,IMINUS)
      CALL LOC(IP,JJ+1,JPOIP,JPSIP,YBARP,IPLUS)
      IF(JPSIM.NE.0)   GO TO 305
      PART1B=0.0
      GO TO 306
  305 TOPM=RK(IM,JPOIM-1)*SIN(THETA(IM,JPOIM-1))
      BOTM=RK(IM,JPSIM)*SIN(THETA(IM,JPSIM))
      TOTB=0.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-0.5*(Y(IM,JPSIM+1)+
     *   Y(IM,JPSIM))
      DUMPB=0.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-YBARP
      PART1B=((TOTB-DUMPB)*(TOPM-BOTM)/TOTB)+BOTM
  306 IF(JPSIP.NE.0)   GO TO 307
      PART1A=0.0
      GO TO 308
  307 TOPP=RK(IP,JPOIP-1)*SIN(THETA(IP,JPOIP-1))
      BOTP=RK(IP,JPSIP)*SIN(THETA(IP,JPSIP))
      TOTA=0.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-0.5*(Y(IP,JPSIP+1)+Y(IP,JPSIP
     *    ))
      DUMPA=0.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-YBARP
      PART1A=((TOTA-DUMPA)*(TOPP-BOTP)/TOTA)+BOTP
  308 PART1=TAU*PART1B+(1.-2.*TAU)*PART1C+TAU*PART1A
      IF(JPSIM.EQ.0)PART1=(1.-TAU)*PART1C+TAU*PART1A
      IF(JPSIP.EQ.0)PART1=TAU*PART1B+(1.-TAU)*PART1C
      ARG=((PART1+PART2*PART3)/RK(I,JJ))
C*IF THE ROUTINE IS TO BLOWUP,USE SNELLS LAW.
      IF(ABS(ARG).LE.1.0)   GO TO 41
      ARG=(C(I,JJ)/C(I,JJ+1))*SIN(THETA(I,JJ+1))
      IF(ARG.GT.1.0)   ARG=1.0
      THETA(I,JJ)=ASIN(ARG)
      GO TO 42
  41  THETA(I,JJ)=ASIN(ARG)
  42  THETA(I,JJ)=0.5*(THETA(I,JJ)+OLDANG(I,JJ))
      SUMANG=SUMANG+(ABS(THETA(I,JJ)-OLDANG(I,JJ)))
 40   CONTINUE
 60   CONTINUE
C*MUST EJECT IF WE HAVE REACHED AN ACCEPTABLE ITERATION ERROR
C*IF THE SUM OF THE ABSOLUTE VALUE OF ANGLE CHANGES DURING AN ITERATION
C*      AVERAGES LESS THAN 0.02 DEGREES PER GRID ITS CLOSE ENOUGH.
      IF(SUMANG.LT.(NPTS*0.0035))   GO TO 215
      IF(NITER.GE.50)   GO TO 215
 100  CONTINUE
      WRITE(2,803)
 215  CONTINUE
C*ITERATION LOOP FOR THE WAVE HEIGHT.
      DO 501 NITER=1,NITERS
      SUMH=0.0
      DO 510  II=IBEGIN,IEND
C*MUST HAVE IT SET UP SO THAT  THE KNOWN BOUNDARIES HTS. AREN'T RECOMP
      IF(ISTART.EQ.IBEGIN)   I=II
      IF(ISTART.EQ.IBEGIN  .AND.  I.EQ.IBEGIN)  GO TO 510
      IF(ISTART.EQ.IEND)   I=IEND-II+IBEGIN
      IF(ISTART.EQ.IEND  .AND.  I.EQ.IEND)   GO TO 510
C*ADX EQUALS ACTUAL DELTA X ACROSS SPACE STEP.
C*ONLY ON BOUNDARIES WHERE FORWARD OR BACKWARD DIFFERENCING.
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      IF(I.NE.IBEGIN)   GO TO 503
      ADX=DX
      IP=I+1
      IM=I
      GO TO 505
503     IF(I.NE.IEND)   GO TO 504
      ADX=DX
      IP=I
      IM=I-1
      GO TO 505
504    ADX=2.0*DX
      IP=I+1
      IM=I-1
505     CONTINUE
      HNONBR(JMAX)=H(I,JMAX)
      DO 502 J=JBEGIN(I),JEND(I)-1
      JJ=JEND(I)-1-J+JBEGIN(I)
      HOLD(I,JJ)=H(I,JJ)
      YBAR=0.25*(Y(I,JJ)+2.0*Y(I,JJ+1)+Y(I,JJ+2))
      CALL LOC(IM,JJ,JOIM,JSIM,YBAR,IMINUS)
      CALL LOC(IP,JJ,JOIP,JSIP,YBAR,IPLUS)
      PART13=(H(I,JJ+1)**2.)*CG(I,JJ+1)*COS(THETA(I,JJ+1))
      PART2=DY(I,JJ)/ADX
      IF(JSIM.NE.0)   GO TO 311
      PART4B=0.0
      GO TO 312
  311 TOPIMH=(H(IM,JOIM-1)**2.)*CG(IM,JOIM-1)*(SIN(THETA(IM,JOIM-1)))
      BOTIMH=(H(IM,JSIM)**2.)*CG(IM,JSIM)*SIN(THETA(IM,JSIM))
      TOTALB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-0.5*(Y(IM,JSIM+1)+Y(IM,JSIM))
      DUMB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-YBAR
      PART4B=((TOTALB-DUMB)*(TOPIMH-BOTIMH)/TOTALB)+BOTIMH
  312 IF(JSIP.NE.0)   GO TO 313
      PART4A=0.0
      GO TO 314
  313 TOPIPH=(H(IP,JOIP-1)**2.)*CG(IP,JOIP-1)*SIN(THETA(IP,JOIP-1))
      BOTIPH=(H(IP,JSIP)**2.)*CG(IP,JSIP)*SIN(THETA(IP,JSIP))
      TOTALA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-0.5*(Y(IP,JSIP+1)+Y(IP,JSIP))
      DUMA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-YBAR
      PART4A=((TOTALA-DUMA)*(TOPIPH-BOTIPH)/TOTALA)+BOTIPH
  314 PART4=PART4A-PART4B
      YBARP=0.25*(Y(I,JJ+1)+2.*Y(I,JJ+2)+Y(I,JJ+3))
      CALL LOC(IM,JJ+1,JPOIM,JPSIM,YBARP,IMINUS)
      CALL LOC(IP,JJ+1,JPOIP,JPSIP,YBARP,IPLUS)
      IF(JPSIM.NE.0)   GO TO 315
      PART12=0.0
      GO TO 316
  315 TOPMH=(H(IM,JPOIM-1)**2)*CG(IM,JPOIM-1)*COS(THETA(IM,JPOIM-1))
      BOTMH=(H(IM,JPSIM)**2)*CG(IM,JPSIM)*COS(THETA(IM,JPSIM))
      TOTB=.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-.5*(Y(IM,JPSIM+1)+Y(IM,JPSIM))
      DUMPB=0.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-YBARP
      PART12=((TOTB-DUMPB)*(TOPMH-BOTMH)/TOTB)+BOTMH
  316 IF(JPSIP.NE.0)   GO TO 317
      PART11=0.0
      GO TO 318
  317 TOPPH=(H(IP,JPOIP-1)**2)*CG(IP,JPOIP-1)*COS(THETA(IP,JPOIP-1))
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      BOTPH=(H(IP,JPSIP)**2)*CG(IP,JPSIP)*COS(THETA(IP,JPSIP))
      TOTA=.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-.5*(Y(IP,JPSIP+1)+Y(IP,JPSIP))
      DUMPA=0.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-YBARP
      PART11=((TOTA-DUMPA)*(TOPPH-BOTPH)/TOTA)+BOTPH
  318 PART1H=TAU*PART12+(1.-2.*TAU)*PART13+TAU*PART11
      IF(JPSIM.EQ.0)PART1H=(1.-TAU)*PART13+TAU*PART11
      IF(JPSIP.EQ.0)PART1H=TAU*PART12+(1.-TAU)*PART13
      ARG=((PART1H+PART2*PART4)/(CG(I,JJ)*COS(THETA(I,JJ))))
C*IF THERE IS TO BE AN INVALID SORT,USE LINEAR SHOALING.
      IF(ARG.GE.0.)   GO TO 44
      ARG=(CG(I,JJ+1)*COS(THETA(I,JJ+1)))/(CG(I,JJ)*COS(THETA(I,JJ)))
      IF(ARG.LT.0.0)   ARG=0.0
      H(I,JJ)=H(I,JJ+1)*SQRT(ARG)
      GO TO 45
   44 H(I,JJ)=SQRT(ARG)
   45 H(I,JJ)=0.5*(H(I,JJ)+HOLD(I,JJ))
      HNONBR(JJ)=H(I,JJ)
C*IBREAK(I)=JJ, THEREFORE JJ WILL BE LEEWARD SIDE OF GRID AT INIT BREAK
      IF(HB(I,JJ) .LT. H(I,JJ) .AND. HB(I,JJ+1).GE.HNONBR(JJ+1))
     *       IBREAK(I)=JJ
      IF(HB(I,JJ).LT.H(I,JJ))   H(I,JJ)=HB(I,JJ)
      SUMH=SUMH+ABS(H(I,JJ)-HOLD(I,JJ))
  502 CONTINUE
  510 CONTINUE
      IBREAK(IEND)=IBREAK(IEND-1)
      IBREAK(IBEGIN)=IBREAK(IBEGIN+1)
      IF(SUMH.LT.(NPTS*0.01))   GO TO 507
      IF(NITER.GE.50)   GO TO 507
  501 CONTINUE
      WRITE(2,803)
  507 CONTINUE
  802 FORMAT(2X,4(F15.5),//)
  803 FORMAT(2X,"AFTER NITERS ITERATIONS, CONVERGENCE WAS NOT REACHED")
  804 FORMAT(2X,"THE WAVE HT. ROUTINE CONVERGED IN, NITER= ",I5,//)
  805 FORMAT(2X,"THIS IS MY CHECKING WRITE STATEMENT")
  806  FORMAT(2X,"THE WAVE ANGLE ROUTINE CONVERGED IN, NITER= ",I5,//)
      RETURN
      END
      SUBROUTINE DIFF(RHOND,THETAO,ANGLE,AMP)
C****DIFFRACTION ABOUT SEMI INFINITE BREAKWATER (PENNE -FRICE)
      PI=3.14159265
      ABSS=SIN(0.5*(ANGLE-THETAO))
      ABSP=SIN(0.5*(ANGLE+THETAO))
      ABC=COS(ANGLE-THETAO)
      ABC1=COS(ANGLE+THETAO)
      XX=RHOND*ABC
      XXC=COS(XX)
      XXS=SIN(XX)
      XX1=RHOND*ABC1
      XXC1=COS(XX1)
      XXS1=SIN(XX1)
      AL=SQRT(RHOND/PI)
      SIG=2.0*AL*ABSS
      SIGP=-2.0*AL*ABSP
      CALL FRES(SIG,C,S,FR,FI)
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      CALL FRES(SIGP,CP,SP,FRP,FIP)
      SUM1=XXC*FR+XXS*FI+XXC1*FRP+XXS1*FIP
      SUM2=XXC*FI-XXS*FR+XXC1*FIP-XXS1*FRP
      AMP=SQRT(SUM1**2+SUM2**2)
      RETURN
      END
      SUBROUTINE FRES(A,C,S,FR,FI)
C*FRESNEL INTEGRAL SUBROUTINE****AFTER ABROMOWITZ AND STEGUN.
      Z=ABS(A)
      P02=1.5707963
      FZ=(1.0+0.926*Z)/(2.0+1.792*Z+3.104*Z*Z)
      GZ=1.0/(2.0+4.142*Z+3.492*Z*Z+6.670*Z*Z*Z)
      XX=P02*Z*Z
      CZ=COS(XX)
      SZ=SIN(XX)
      C=0.5-GZ*CZ+FZ*SZ
      S=0.5-FZ*CZ-GZ*SZ
      IF(A.GT.0.0)   GO TO 50
      C=-C
      S=-S
   50 FR=0.5*(1.0+C+S)
      FI=-0.5*(S-C)
      RETURN
      END
      SUBROUTINE PREDIF
      PARAMETER(NI=53,NJ=11)
C*************************************************************************
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      DIMENSION J1(NI),J2(NI),J1REF(NI),J3REF(NI)
      DO 99 J=1,IMAX+3
      J1(J)=0
      J2(J)=0
      J1REF(J)=0
   99 CONTINUE
C*THIS SUB CALCS WHERE DIFFRACTION GOVERNS AND WHERE REFRACT GOVERNS.
C*IT WILL CALL REFRAC FOR OFFSHORE AREA(OFF TIP OF STRUCTURE).
C*THEN IT WILL DO THE SHADOW ZONE USING DIFF(IF THETAO .NE.0.0)
C* IT WILL THEN FINISH THE  OTHERS USING REFRAC AGAIN.
C*NOW, LETS FIND C,CG,RK,HB, AND WVNUM.
      DO 202 I=1,IMAX+1
      DO 202 J=1,JMAX+2
      DEPTH=DEEP(I,J)
      CALL WVNUM(DEPTH,T,DUMK)
      RK(I,J)=DUMK
      C(I,J)=CO*TANH(RK(I,J)*DEEP(I,J))
      EN=0.5*(1.0+((2.*RK(I,J)*DEEP(I,J))/SINH(2.*RK(I,J)*DEEP(I,J))))
      CG(I,J)=EN*C(I,J)
      HB(I,J)=0.78*DEEP(I,J)
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      H(I,J)=HB(I,J)
  202 CONTINUE
C*WILL ATTRIB AN EQUAL REACH TO EACH SIDE OF EACH M-GROIN.
      DO 200 M=1,MMAX
      IDUML=1
      IF(M.NE.1) IDUML=(IJET(M)+IJET(M-1))/2
      IDUMR=IMAX
      IF(M.NE.MMAX) IDUMR=(IJET(M)+IJET(M+1))/2
      NPTS=0
      DO 1 I=IDUML,IDUMR
      DO 2 J=1,JMAX
      IF(Y(I,J).LT.SJETTY(M))   GO TO 14
      J1(I)=J
      J2(I)=JMAX
      GO TO 15
   14 CONTINUE
    2 CONTINUE
   15 CONTINUE
C*IF NO STRUCT IS PRESENT(SJETTY=0.0), DO REFRAC THRUOUT GRID SYSTEM
      IF(SJETTY(M).EQ.0.0)   J1(I)=1
    1 CONTINUE
      DO 16 I=IDUML,IDUMR
C*  \REFRAC\ STARTS ON THE NEXT TO LAST J-CONTOUR,NOT THE LAST?
      DO 16 J=J1(I),J2(I)-1
   16 NPTS=NPTS+1
C*WILL NOW DO THE REFRACT FOR THE REGION 1 AREA.
C*ISTART REPRESENTS THE DIRECTION THE SWEEPS WILL BEGIN FROM.
C*WILL USE DUMMY IMAX,IJET,IJET+1 IN CALL STTS SO IBEGIN,IEND, AND
C***ISTART  WON\T CHANGE THEM.MUST RESET AFTER EACH CALL REFRAC.
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      IF(ANGGEN.GE.0.0) CALL REFRAC(J1,J2,NPTS,IDUMLL,IMAXT,IDUMLL,M)
      IF(ANGGEN.LT.0.0) CALL REFRAC(J1,J2,NPTS,IDUMLL,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      JDUMN=J1(IJET(M))
      JDUMS=J1(IJET(M)+1)
      XDISTN=(IJET(M)-1.0)*DX+DX/2.
      ELTIP=T*0.5*(C(IJET(M),JDUMN)+C(IJET(M)+1,JDUMS))
C*NOW MUST CHECK THE ANGLE AT THE STRUCTURE\S TIP TO SEE WHERE SHAD ZONE
C*IF NO STRUCT PRESENT(SJETTY(M)=0.0), FUTHER REFRAC/DIFF UNNECESSARY.
      IF(SJETTY(M).EQ.0.0)   GO TO 13
      THETAO(M)=0.5*(THETA(IJET(M),JDUMN)+THETA(IJET(M)+1,JDUMS))
      HINC=0.5*(H(IJET(M),JDUMN)+H(IJET(M)+1,JDUMS))
      IF(THETAO(M))10,11,12
C*THIS SECTION HANDLES REFRAC/DIFF IF THETAO)0.0.
   10 CONTINUE
C*FIRST ALL OF REGION 2 WILL GET REFRACTED.
      NPTS=0
      DO 100 I=IJET(M)+1,IDUMR
      J2(I)=J1(I)
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  100 J1(I)=1
       DO 101 I=IJET(M)+1,IDUMR
       DO 101 J=J1(I),J2(I)-1
  101 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IJETP1,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
C*NOW MUST DO REGION 3 OF NEG THETAO CASE-SHADOW ZONE.
      DO 102 I=IDUML,IJET(M)
      J2(I)=J1(I)
  102 J1(I)=1
      DO 103 I=IDUML,IJET(M)
      J1REF(I)=1
      DO 104 J=J1(I),J2(I)+1
      XCOOR=(I-1.0)*DX
      YCOOR=0.5*(Y(I,J)+Y(I,J+1))
      ANGLE=ATAN((XDISTN-XCOOR)/(SJETTY(M)-YCOOR))
      IF(YCOOR.GT.SJETTY(M))   ANGLE=PI+ANGLE
C*IF MOST SHOREWARD PT OUT OF SHAD ZONE, SO ARE THE OTHERS FOR THAT I.
      IF(ABS(ANGLE).GT.ABS(THETAO(M)))   GO TO 105
      RAD=SQRT((XDISTN-XCOOR)**2+(SJETTY(M)-YCOOR)**2)
      RHOND=RAD*TWOPI/ELTIP
C*DIFFRACTION TREATS THE POS THETAO CASE.
      THE=ABS(THETAO(M))
      CALL DIFF(RHOND,THE,ANGLE,AMP)
      H(I,J)=AMP*HINC
      ANGRAD=-ANGLE
C*WILL NOW REFRACT DIFF WAVES IN THE SHAD ZONE USING SNELL'S.
      CTIP=ELTIP/T
       ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *  (Y(I-1,J)+Y(I-1,J+1)))/(2.*DX))
      IF(I.EQ.IJET(M))ALPHAS(I,J)=ATAN((0.5*(Y(I,J)+Y(I,J+1))-0.5*(Y(I-1
     *    ,J)+Y(I-1,J+1)))/DX)
      DALPHA=ANGRAD-ALPHAS(I,J)
      ARG=(C(I,J)/CTIP)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(I,J)=ASIN(ARG)
      THETA(I,J)=THETA(I,J)+ALPHAS(I,J)
C*MUST CHECK TO SEE IF WAVE WOULD HAVE BROKEN.
      IF(HB(I,J).LE.H(I,J).AND.HB(I,J+1).GT.H(I,J+1))IBREAK(I)=J
      IF(HB(I,J).LT.H(I,J))   H(I,J)=HB(I,J)
  104 CONTINUE
      GO TO 103
  105 J1REF(I)=J
  103 CONTINUE
C*NOW MUST DO REFRACTION FOR REGION 4.
      NPTS=0
       DO 106 I=IDUML,IJET(M)
      DO 106 J=J1REF(I),J2(I)-1
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  106 NPTS=NPTS+1
      IDUMLL=IDUML
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1REF,J2,NPTS,IDUMLL,IJETT,IDUMLL,M)
      IDUMLL=IDUML
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      GO TO 13
C*THIS HANDLES REFRAC/DIFF IF THETAO IS 0.0.
C*FOR THIS CASE, ONLY THREE REGIONS EXIST.
   11 CONTINUE
      NPTS=0
      DO 120 I=IDUML,IJET(M)
      J2(I)=J1(I)
  120 J1(I)=1
      DO 121 I=IDUML,IJET(M)
      DO 121 J=J1(I),J2(I)-1
  121 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IDUMLL,IJETT,IDUMLL,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      DO 122 I=IJET(M)+1,IDUMR
      J2(I)=J1(I)
  122 J1(I)=1
      NPTS=0
      DO 123 I=IJET(M)+1,IDUMR
      DO 123 J=J1(I),J2(I)-1
  123 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IJETP1,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      GO TO 13
C*THIS SECTION HANDLES REFRACT/DIFF IF THETAO;0.0
   12 CONTINUE
C*FIRST, REGION 2- ALL REFRACTION.
      NPTS=0
      DO 110 I=IDUML,IJET(M)
      J2(I)=J1(I)
  110 J1(I)=1
      DO 111 I=IDUML,IJET(M)
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      DO 111 J= J1(I),J2(I)-1
  111 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IDUMLL,IJETT,IDUMLL,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
C*NOW WILL DO REGION 3 OF THE POS THETAO CASE.
      DO 112 I=IJET(M)+1,IDUMR
      J2(I)=J1(I)
  112 J1(I)=1
      DO 113 I=IJET(M)+1,IDUMR
      J1REF(I)=1
C*WILL GO ONE PT. BEYOND J2(I) TO MAKE SURE OUTOF DIFF ZONE.
      DO 114 J=J1(I),J2(I)+1
      XCOOR=(I-1.0)*DX
      YCOOR=0.5*(Y(I,J)+Y(I,J+1))
      ANGLE=ATAN((XCOOR-XDISTN)/(SJETTY(M)-YCOOR))
      IF(YCOOR.GT.SJETTY(M))   ANGLE=PI+ANGLE
C*IF LEAST J-VALUE IS OUT OF SHAD ZONE,SO ARE OTHER J\S.(FOR EACH I)
      IF(ANGLE.GT.ABS(THETAO(M)))   GO TO 115
      RAD=SQRT((XCOOR-XDISTN)**2+(SJETTY(M)-YCOOR)**2)
      RHOND=RAD*TWOPI/ELTIP
      THE=THETAO(M)
      CALL DIFF(RHOND,THE,ANGLE,AMP)
      ANGRAD=ANGLE
C*WILL NOW REFRACT DIFFRACTED WAVES IN SHAD ZONE USING SNELL\S.
      CTIP=ELTIP/T
      ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *  (Y(I-1,J)+Y(I-1,J+1)))/(2.*DX))
      IF(I.EQ.IJET(M)+1)ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *   (Y(I,J)+Y(I,J+1)))/DX)
      DALPHA=ANGRAD-ALPHAS(I,J)
      ARG=(C(I,J)/CTIP)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(I,J)=ASIN(ARG)
      THETA(I,J)=THETA(I,J)+ALPHAS(I,J)
      H(I,J)=HINC*AMP
C*MUST CHECK TO SEE IF WAVE WOULD HAVE BROKEN.
      IF(HB(I,J).LE.H(I,J).AND.HB(I,J+1).GT.H(I,J+1))IBREAK(I)=J
      IF(HB(I,J).LT.H(I,J))   H(I,J)=HB(I,J)
  114 CONTINUE
      GO TO 113
  115 J1REF(I)=J
  113 CONTINUE
C*NOW MUST DO REFRAC FOR REGION 4.
      NPTS=0
      DO 116 I=IJET(M)+1,IDUMR
      DO 116 J=J1REF(I),J2(I)-1
  116 NPTS=NPTS+1
      IMAXT=IDUMR
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      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1REF,J2,NPTS,IJETP1,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
   13 CONTINUE
  200 CONTINUE
      RETURN
      END
      SUBROUTINE LOC(IM,JJ,JOIM,JSIM,YBAR,IDUM)
      PARAMETER(NI=53,NJ=11)
C*****************************************************************************
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
C*SUBROUTINE LOC FINDS J-VALUES WHICH ARE GREATER AND LESS THAN YBAR.
      JOIM=2
    2 AA=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))
      IF(AA.GT.YBAR)   GO TO 4
      JOIM=JOIM+1
C*THE FOLLOWING IS REQ\D SO THAT DY/DX;0.5
C*WILL DTERMINE K SIN THETA ON IM-LINE AT A DIST YBAR.
C*WILL CALL THIS POINT    JUSE+1.
      IF(JOIM.LE.JUSE)   GO TO 2
      JOIM=JUSE+1
      Y(IM,JOIM)=YBAR
C* DEPTH AT THIS POINT WILL BE COMP ASSUMING CONST BEACH SLOPE ON I=IM
      DEL=.5*(Y(IM,JOIM-1)+Y(IM,JOIM-2))-.5*(Y(IM,JOIM-2)+Y(IM,JOIM-3))
      BSLOPE=(DEEP(IM,JOIM-2)-DEEP(IM,JOIM-3))/DEL
      DEEP(IM,JOIM-1)=DEEP(IM,JOIM-2)+BSLOPE*(Y(IM,JOIM)-Y(IM,JOIM-1))
      IF(DEEP(IM,JOIM-1).GT.WDEPTH) DEEP(IM,JOIM-1)=WDEPTH
      DEPTH=DEEP(IM,JOIM-1)
      CALL WVNUM(DEPTH,T,DUMK)
      RK(IM,JOIM-1)=DUMK
      C(IM,JOIM-1)=CO*TANH(RK(IM,JOIM-1)*DEEP(IM,JOIM-1))
      EN=0.5*(1.0+((2.0*RK(IM,JOIM-1)*DEEP(IM,JOIM-1))/SINH(
     *   2.*RK(IM,JOIM-1)*DEEP(IM,JOIM-1))))
      CG(IM,JOIM-1)=C(IM,JOIM-1)*EN
C*WILL USE SNELL\S LAW TO  DETERMINE THE WAVE ANGLE HERE
C*ANGLE OF CONTOUR WILL BE ASSUME TO BE THE SAME AS THE JMAX+1 CONTOUR
      IF(IDUM.EQ.1)ALPH=ATAN((Y(IM,JOIM-1)-Y(IM-1,JOIM-1))/DX)
      IF(IDUM.EQ.-1)ALPH=ATAN((Y(IM+1,JOIM-1)-Y(IM,JOIM-1))/DX)
      DALPHA=ANGGEN-ALPH
      ARG=(C(IM,JOIM-1)/CGEN)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(IM,JOIM-1)=ASIN(ARG)
      THETA(IM,JOIM-1)=THETA(IM,JOIM-1)+ALPH
    4  JSIM=JMAX-1
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 6    AA=0.5*(Y(IM,JSIM)+(Y(IM,JSIM+1)))
      IF(AA.LT.YBAR)   GO TO 8
      JSIM=JSIM-1
C*IF JSIM=0,THERE IS NO ADJ PT, SUB REFRAC CAN HANDLE IT.
      IF(JSIM.EQ.0)   GO TO 8
      GO TO 6
 8    RETURN
      END
      SUBROUTINE WVNUM(DEPTH,T,RK)
C*****************************************************************
      G=32.17
      EPS=0.001
      TWOPI=6.283185307
      SIGMA=TWOPI/T
      RK=TWOPI/(T*SQRT(G*DEPTH))
      DO 100 IT=1,20
      ARG=RK*DEPTH
      EK=(G*RK*TANH(ARG))-(SIGMA**2)
      EKPR=G*(ARG*((SECH(ARG))**2)+TANH(ARG))
      RKNEW=RK-EK/EKPR
      IF(ABS(RKNEW-RK).LE.ABS(EPS*RKNEW))   GO TO 120
      RK=RKNEW
 100  CONTINUE
      WRITE(2,1000)   IT,DEPTH,RK
 1000 FORMAT(///,10X,"ITERATION FOR K FAILED TO CONVERGE AFTER"
     *  ,3X,I3,"ITERATION",/,"OUTPUT00000DEPTH, RK",3X,2F13.5)
      CALL EXIT
 120  RK=RKNEW
      IF(RK.GT.0.0)   GO TO 140
      WRITE(2,1020)   DEPTH,RK
 1020 FORMAT(///,10X," RK IS NEG",/," OUTPUT DEPTH,RK",3X,2F13.5)
      CALL EXIT
 140  RETURN
      END
      SUBROUTINE SMOOTH(THETA,IMAX,JMAX,IJET,SJETTY,MMAX,Y)
      PARAMETER(NI=53,NJ=11)
C*****************************************************************
C*THIS WILL SMOOTH THE WAVE ANGLE FIELD TO ACCT FOR DIFF(ARTIFICIALLY)
      DIMENSION TEMP(NI,NJ),Y(NI,NJ),THETA(NI,NJ),IJET(10),SJETTY(10)
C*(MMAX+1) IS REQ'D BECAUSE M-GROINS HAVE M+1 REACHES OF SHORELINE.
      SJETTY(MMAX+1)=0.
       DO 10 M=1,MMAX+1
      IF(M.NE.1)   GO TO 3
      ILEFT=2
      IRIGHT=IJET(1)
      GO TO 5
   3  IF(M.NE.MMAX+1)   GO TO 4
      ILEFT=IJET(MMAX)+1
      IRIGHT=IMAX-1
      GO TO 5
   4  ILEFT=IJET(M-1)+1
      IRIGHT=IJET(M)
   5  CONTINUE
      DO 1 J=1,JMAX-1
      DO 1 I=ILEFT,IRIGHT
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      IF(I.NE.ILEFT.AND.I.NE.IRIGHT)   GO TO 15
C*TO GET HERE, MUST BE ON BOUN OR ADJ TO A STRUCTURE.
      IF(I.EQ.2.OR.I.EQ.IMAX-1)   GO TO 15
C*TO GET HERE,ADJ TO A STRUCT AND CAN BE ILEFT OR IRIGHT.
      IF(Y(I,J).GE.SJETTY(M))   GO TO 15
C*IF HERE, WITHIN JETTY AND ADJ TO EITHER SIDE.
      IF(I.EQ.ILEFT)TEMP(I,J)=0.5*(THETA(I,J)+THETA(I+1,J))
      IF(I.EQ.IRIGHT)TEMP(I,J)=0.5*(THETA(I,J)+THETA(I-1,J))
      GO TO 1
   15 TEMP(I,J)=0.25*THETA(I-1,J)+0.50*THETA(I,J)+0.25*THETA(I+1,J)
    1 CONTINUE
   10 CONTINUE
       DO 2 J=1,JMAX-1
      DO 2 I=2,IMAX-1
    2 THETA(I,J)=TEMP(I,J)
      RETURN
      END
      FUNCTION SECH(A)
C***********************************************************************
      SECH=1.0/COSH(A)
      RETURN
C****HERE IS WHERE THE IMSL ROUTINES MUST GO
        END
      SUBROUTINE BRKH20(IMAX,JMAX,MMAX,Y,THETA,H,C
     1,IJET,SJETTY,T,DX,DEEP,HB,CG)
      PARAMETER(NI=53,NJ=11)
      COMMON/NWS/ILFT(5),IRT(5),YLFT(5),YRT(5),NOBKS
     1,DEEPR(5),DEEPL(5),HRT(5),HLFT(5)
      DIMENSION THETAL(5),THETLL(5),THETAR(5),THETRR(5)
     1,XXL(5),XXR(5),CLFT(5),CRT(5),HTEMPR(5
     1,HTEMPL(5),HTXL(5),HTYL(5),HTXR(5),HTYR(5)
     1,YLLFT(5),YRRT(5),DXL(5),DXR(5),BKANG(5)
     1,CGRT(5),CGLFT(5)
      DIMENSION Y(NI,NJ),THETA(NI,NJ),H(NI,NJ),C(NI,NJ)
     1,IJET(10),SJETTY(10),DEEP(NI,NJ),HB(NI,NJ),CG(NI,NJ)
      PI=3.14159
      TWOPI=2.*PI
      DO 500 N=1,NOBKS
      XXDIST=DX*(IRT(N)-ILFT(N))
      BKANG(N)=ATAN((YRT(N)-YLFT(N))/XXDIST)
      DXL(N)=0.0
      DXR(N)=0.0
      DO 300 J=1,JMAX
      JJ=JMAX-J+2
      IF(YLFT(N).LT.Y(ILFT(N),JJ).AND.YLFT(N).GE.Y(ILFT(N)
     1,JJ-1)) GO TO 350
      GO TO 300
  350 FACT=(Y(ILFT(N),JJ)-YLFT(N))/(Y(ILFT(N),JJ)-Y(ILFT(N),
     1JJ-1))
      DEEPL(N)=DEEP(ILFT(N),JJ)-(DEEP(ILFT(N),JJ)-DEEP
     1(ILFT(N),JJ-1))*FACT
      THETAL(N)=THETA(ILFT(N),JJ)-(THETA(ILFT(N),JJ)-THETA
     1(ILFT(N),JJ-1))*FACT
      HLFT(N)=H(ILFT(N),JJ)-(H(ILFT(N),JJ)-H(ILFT(N),JJ-1))
     1*FACT
```

```
      CLFT(N)=C(ILFT(N),JJ)-(C(ILFT(N),JJ)-C(ILFT(N),JJ-1))
     1*FACT
      CGLFT(N)=CG(ILFT(N),JJ)-(CG(ILFT(N),JJ)-CG(ILFT(N),JJ-1))
     1*FACT
  300 CONTINUE
      DO 400 J=1,JMAX
      JJ=JMAX-J+2
      IF(YRT(N).LT.Y(IRT(N),JJ).AND.YRT(N).GE.Y(IRT(N),JJ-1)
     1) GO TO 450
      GO TO 400
  450 FACT=(Y(IRT(N),JJ)-YRT(N))/(Y(IRT(N),JJ)-Y(IRT(N),JJ-1))
      DEEPR(N)=DEEP(IRT(N),JJ)-(DEEP(IRT(N),JJ)-DEEP(IRT(N)
     1,JJ-1))*FACT
      THETAR(N)=THETA(IRT(N),JJ)-(THETA(IRT(N),JJ)-THETA(IRT(N)
     1,JJ-1))*FACT
      HRT(N)=H(IRT(N),JJ)-(H(IRT(N),JJ)-H(IRT(N),JJ-1))*FACT
      CRT(N)=C(IRT(N),JJ)-(C(IRT(N),JJ)-C(IRT(N),JJ-1))*FACT
      CGRT(N)=CG(IRT(N),JJ)-(CG(IRT(N),JJ)-CG(IRT(N),JJ-1))*FACT
  400 CONTINUE
      YLLFT(N)=YLFT(N)
      YRRT(N)=YRT(N)
      THETLL(N)=THETAL(N)
      THETRR(N)=THETAR(N)
C     WRITE(2,501) N,BKANG(N),DEEPL(N),THETAL(N),HLFT(N),CLFT(N)
C    1,CGLFT(N),DEEPR(N),THETAR(N),HRT(N),CRT(N),CGRT(N),YLLFT(N)
C    1,YRRT(N),THETLL(N),THETRR(N)
  501 FORMAT((I5,7F10.4)/(8F10.4))
  500 CONTINUE
      IDIST=DX
      DO 1000 J=1,JMAX+1
      JJ=JMAX-J+2
      DO 1100 N=1,NOBKS
      XXL(N)=(YLLFT(N)-Y(ILFT(N),JJ))*TAN(THETLL(N))+DX*(
     1ILFT(N)-1)+DXL(N)
      XXR(N)=(YRRT(N)-Y(IRT(N),JJ))*TAN(THETRR(N))+DX*(IRT(N)-1)
     1+DXR(N)
 1100 CONTINUE
      DO 2000 I=2,IMAX
      CONANG=ATAN((Y(I+1,JJ)-Y(I-1,JJ))/(2.*DX))
      XDUM=(I-1)*DX
      HX=H(I,JJ)*SIN(THETA(I,JJ))
      HY=H(I,JJ)*COS(THETA(I,JJ))
      OUT=0.0
      DO 1800 N=1,NOBKS
      HTEMPR(N)=0.
      HTEMPL(N)=0.
      HTXL(N)=0.
      HTYL(N)=0.
      HTXR(N)=0.
      HTYR(N)=0.
C
      IF(Y(I,JJ).GT.YRT(N)) GO TO 1600
      IF(XDUM.GT.XXR(N)) GO TO 1600
      DELY=YRT(N)-Y(I,JJ)
      DELX=(IRT(N)-I)*DX+.0000001
```

```
      ANG=ATAN(DELY/DELX)
      IF(ANG.LE.BKANG(N)) GO TO 1600
      JSHAD=0
      DO 1400 JTY=1,MMAX
      IF(Y(I,JJ).GT.SJETTY(JTY)) GO TO 1400
      IF(I.GE.IJET(JTY).AND.IJET(JTY).LE.IRT(N)) GO TO 1400
      IF(I.LE.IJET(JTY).AND.IJET(JTY).GE.IRT(N)) GO TO 1400
      ANGJET=ATAN((YRT(N)-SJETTY(JTY))/((IRT(N)-IJET(JTY))*DX))
      IF(ABS(ANGJET).LT.ABS(ANG)) JSHAD=1
 1400 CONTINUE
      IF(JSHAD.EQ.1) GO TO 1600
      DUMANG=SQRT(DEEP(I,JJ)/DEEPR(N))*SIN(PI/2.-ANG)
      IF(DUMANG.GT.1.0) DUMANG=1.0
      ANGG=PI/2.-ASIN(DUMANG)+CONANG
      IF(ANG.LT.0.0) ANGG=-ANGG
      IF(ANG.LT.0.0) ANG=ANG+PI
      IF(ANGG.LT.0.0) ANGG=ANGG+PI
      ANG=ANG-BKANG(N)
      RHOND=(TWOPI/(T*CRT(N)))*SQRT(DELX*DELX+DELY*DELY)
      THE=THETAR(N)+PI/2.-BKANG(N)
      CALL DIFF(RHOND,THE,ANG,AMP)
      HTEMPR(N)=HRT(N)*AMP
      HTXR(N)=-HTEMPR(N)*COS(ANGG)
      HTYR(N)=HTEMPR(N)*SIN(ANGG)
      OUT=OUT+1.0
 1600 CONTINUE
C
      IF(Y(I,JJ).GT.YLFT(N)) GO TO 1800
      IF(XDUM.LT.XXL(N)) GO TO 1800
      DELY=YLFT(N)-Y(I,JJ)
      DELX=(I-ILFT(N))*DX+.0000001
      ANG=ATAN(DELY/DELX)
      IF(ANG.LE.BKANG(N)) GO TO 1800
      JSHAD=0
      DO 1700 JTY=1,MMAX
      IF(Y(I,JJ).GT.SJETTY(JTY)) GO TO 1700
      IF(I.LE.IJET(JTY).AND.IJET(JTY).GE.ILFT(N)) GO TO 1700
      IF(I.GE.IJET(JTY).AND.IJET(JTY).LE.ILFT(N)) GO TO 1700
      ANGJET=ATAN((YLFT(N)-SJETTY(JTY))/((IJET(JTY)-ILFT(N))*DX))
      IF(ABS(ANGJET).LT.ABS(ANG)) JSHAD=1
 1700 CONTINUE
      IF(JSHAD.EQ.1) GO TO 1800
      DUMANG=SQRT(DEEP(I,JJ)/DEEPL(N))*SIN(PI/2.-ANG)
      IF(DUMANG.GT.1.0) DUMANG=1.0
      ANGG=PI/2.-ASIN(DUMANG)-CONANG
      IF(ANG.LT.0.0) ANGG=-ANGG
      IF(ANG.LT.0.0) ANG=ANG+PI
      IF(ANGG.LT.0.0) ANGG=ANGG+PI
      ANG=ANG+BKANG(N)
      RHOND=(TWOPI/(T*CLFT(N)))*SQRT(DELY*DELY+DELX*DELX)
      THE=PI/2.-THETAL(N)+BKANG(N)
      CALL DIFF(RHOND,THE,ANG,AMP)
      HTEMPL(N)=HLFT(N)*AMP
      HTXL(N)=HTEMPL(N)*COS(ANGG)
      HTYL(N)=HTEMPL(N)*SIN(ANGG)
```

```
      OUT=OUT+1.
 1800 CONTINUE
      SHADOW=1.0
      IF(OUT.LT..5) GO TO 2000
      DO 1801 N=1,NOBKS
      DD=YLFT(N)+(XDUM-DX*(ILFT(N)-1))*TAN(BKANG(N))
      IF(XDUM.GT.XXL(N).AND.XDUM.LT.XXR(N).AND.Y(I,JJ).LT.DD) SHADOW=0.0
      HX=HX*SHADOW
      HY=HY*SHADOW
C
C

 1801 CONTINUE
      HXT=0.0000001
      HYT=0.0000001
      DO 1900 N=1,NOBKS
      HXT=HXT+HTXL(N)*ABS(HTXL(N))+HTXR(N)*ABS(HTXR(N))
      HYT=HYT+HTYL(N)*ABS(HTYL(N))+HTYR(N)*ABS(HTYR(N))
 1900 CONTINUE
      XXX=ABS(HX)*HX+HXT
      YYY=ABS(HY)*HY+HYT
      H(I,JJ)=SQRT(ABS(XXX)+ABS(YYY))
      IF(H(I,JJ).GT.HB(I,JJ)) H(I,JJ)=HB(I,JJ)
      THETA(I,JJ)=ATAN((XXX/SQRT(ABS(XXX)))/(YYY/SQRT(ABS(YYY))))
 2000 CONTINUE
      DO 1950 N=1,NOBKS
      IF(Y(ILFT(N),JJ).GT.YLFT(N)) GO TO 1960
      YLLFT(N)=Y(ILFT(N),JJ)
      IIXL=XXL(N)
      III=IIXL/IDIST+1
      THETLL(N)=THETA(III,JJ)
      DXL(N)=XXL(N)-DX*(ILFT(N)-1)
 1960 CONTINUE
      IF(Y(IRT(N),JJ).GT.YRT(N)) GO TO 1970
      YRRT(N)=Y(IRT(N),JJ)
      IIXR=XXR(N)
      III=IIXR/IDIST+2
      THETRR(N)=THETA(III,JJ)
      DXR(N)=XXR(N)-DX*(IRT(N)-1)
 1970 CONTINUE
 1950 CONTINUE
 1000 CONTINUE
      RETURN
      END
      SUBROUTINE PLOTNS(IMAX,JMAX,Y,YLFT,YRT,ILFT,IRT,SJETTY,IJET,
     1NOBKS,MMAX)
      PARAMETER(NI=53,NJ=11)
      DIMENSION Y(NI,NJ),YLFT(5),YRT(5),ILFT(5),IRT(5),SJETTY(5)
     1,IJET(5)
      DIMENSION ICHAR(200),IY(6),NN(7)
      DATA NN/1H*,1H0,1H.,1H+,1H#,1HO,1HH/
      DATA NIL/1H /
      IWIDTH=127
C     IWIDTH=75
      YMIN=-50.
```

```
      DO 1 I=1,IMAX
      IF(Y(I,1).GT.YMIN) GO TO 1
      YMIN=Y(I,1)
    1 CONTINUE
      YMAX=Y(1,6)
      DO 2 I=1,IMAX
      IF(Y(I,6).LT.YMAX) GO TO 2
      YMAX=Y(I,6)
    2 CONTINUE
      IF(YMIN.GE.0.) GO TO 3
      SCALE=(YMAX-YMIN)/IWIDTH
      IZERO=-YMIN/SCALE
      GO TO 4
    3 SCALE=YMAX/IWIDTH
      IZERO=50./SCALE
    4 CONTINUE
      DO 500 I=1,IMAX
      DO 10 N=1,127
   10 ICHAR(N)=NIL
      ICHAR(IZERO)=1HI
      DO 20 J=1,6
      IY(J)=Y(I,J)/SCALE+IZERO
      IF(IY(J).LT.1) IY(J)=1
      IF(IY(J).GT.IWIDTH) IY(J)=IWIDTH
   20 ICHAR(IY(J))=NN(J)
      DO 200 N=1,MMAX
      IF(I.EQ.IJET(N)) GO TO 150
      GO TO 200
  150 ILNG=SJETTY(N)/SCALE+IZERO
      IF(ILNG.GT.IWIDTH) ILNG=IWIDTH
      DO 175 M=IZERO,ILNG
  175 ICHAR(M)=NN(7)
  200 CONTINUE
      IF(NOBKS.LT.1) GO TO 301
      DO 300 N=1,NOBKS
      IF(I.GE.ILFT(N).AND.I.LE.IRT(N)) GO TO 250
      GO TO 300
  250 ILNG=YLFT(N)/SCALE+IZERO
      IF(ILNG.GT.IWIDTH) ILNG=IWIDTH
      ICHAR(ILNG)=NN(7)
  300 CONTINUE
  301 CONTINUE
      WRITE(2,30) I,(ICHAR(N),N=1,IWIDTH)
   30 FORMAT(1X,I3,1HI,127A1)
C  30 FORMAT(1X,I3,75A1)
  500 CONTINUE
      RETURN
      END
```

```
/LIST
      PROGRAM DATA(INPUT,OUTPUT,INPUT,SPOOL,TAPE6=OUTPUT,TAPE5=INPUT
     1,TAPE10=INPUT,TAPE20=SPOOL)
      DIMENSION IJET(20),SJETTY(20),ILFT(20),IRT(20),YLFT(20),YRT(20)
     1,Y(100,1),CHANGE(20)
C  THIS PROGRAM ALLOWS THE USER TO CREATE AN  INPUT  FILE CONTAINING
C    THE PROJECT PARAMETERS AND WAVE CONDITIONS,AND A  SPOOL  FILE
C    TO ADJUST THE CONTOUR LOCATIONS.
      DO 1 N=1,20
    1 CHANGE(N)=0.0
      WRITE(6,10)
   10 FORMAT(1X,10HENTER IMAX)
      READ(5,*) IMAX
      WRITE(6,12)
   12 FORMAT(1X,10HENTER JMAX)
      READ(5,*) JMAX
      WRITE(10,14) IMAX,JMAX
   14 FORMAT(2I10)
      WRITE(6,2)
    2 FORMAT(1X,51HENTER THE OFFSHORE BOUNDARY CONTOUR DEPTH IN METERS,
     18H(WDEPTH))
      READ(5,*) WDEPTH
      WRITE(10,7) WDEPTH
    7 FORMAT(10X,F10.3)
      WRITE(6,3)
    3 FORMAT(1X,40HENTER THE DESIRED CONTOUR DEPTHS IN FEET,
     123H(1ST,2ND,3RD,...JMAX+1))
      READ(5,*) (CHANGE(J),J=1,JMAX+1)
      CHANGE(JMAX+2)=WDEPTH*3.28084
      WRITE(10,4) (CHANGE(J),J=1,20)
    4 FORMAT(10F8.3)
      WRITE(6,5)
    5 FORMAT(1X,45HENTER THE DESIRED FREQUENCY OF PRINTED OUTPUT,
     124H(EXAMPLE-EVERY NTH WAVE))
      READ(5,*) NOUTPT
      WRITE(10,6) NOUTPT
    6 FORMAT(I10)
      WRITE(6,17)
   17 FORMAT(1X,14HENTER BERM(FT))
      READ(5,*) BERM
      WRITE(6,18)
   18 FORMAT(1X,11HENTER SFACE)
      READ(5,*) SFACE
      WRITE(6,20)
   20 FORMAT(1X,15HENTER DIAM(MM))
      READ(5,*) DIAM
      WRITE(10,22) BERM,SFACE,DIAM
   22 FORMAT(10X,F10.3,F10.4,F10.3)
      WRITE(6,24)
   24 FORMAT(1X,39HENTER NUMBER OF GROINS(MMAX),0,1,2,ETC.)
      READ(5,*) MMAX
      IF(MMAX.EQ.0) GO TO 30
      DO 26 M=1,MMAX
      WRITE(6,29) M
   29 FORMAT(1X,30HENTER I LOCATION,LENGTH OF NO.,I2,10H GROIN(FT))
   26 READ(5,*) IJET(M),SJETTY(M)
```

```
      GO TO 32
   30 MMAX=1
      IJET(1)=3
      SJETTY(1)=0.00
   32 WRITE(10,29) MMAX
   29 FORMAT(I3)
      DO 36 M=1,MMAX
   36 WRITE(10,34) IJET(M),SJETTY(M)
   34 FORMAT(I3,F10.3)
      WRITE(6,40)
   40 FORMAT(1X,21HENTER ADEAN (FT**1/3))
      READ(5,*) ADEAN
      WRITE(10,42) ADEAN
   42 FORMAT(F10.4)
      WRITE(5,44)
   44 FORMAT(1X,22HENTER DX(FT),DELT(HRS))
      READ(5,*) DX,DELT
      DELT=DELT*3600.
      WRITE(10,46) DX,DELT
   46 FORMAT(2F10.3)
      DELT=DELT*3600.
      DO 61 I=1,IMAX
   61 Y(I,1)=0.0
      WRITE(6,62)
   62 FORMAT(1X,43HSHORELINE IS INITIALLY STRAIGHT(Y(I,1)=0.0)/,
     154HENTER CHANGES BY ENTERING I LOCATION, DISTANCE IN FEET/,
     158HIF NO CHANGES OR TO TERMINATE CHANGES, ENTER IMAX VALUE,0.)
   65 READ(5,*) I,Y(I,1)
      IF(I.EQ.IMAX) GO TO 68
      GO TO 65
   68 WRITE(10,69) (Y(I,1),I=1,IMAX)
   69 FORMAT(10F8.2)
      WRITE(6,48)
   48 FORMAT(1X,31HENTER THE NUMBER OF BREAKWATERS)
      READ(5,*) NOBKS
      WRITE(10,50) NOBKS
   50 FORMAT(I5)
      IF(NOBKS.EQ.0) GO TO 60
      DO 52 N=1,NOBKS
      WRITE(6,54) N
   54 FORMAT(1X,9HENTER NO.,I2,12H BREAKWATER ,
     155HLEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE FT
      READ(5,*) ILFT(N),IRT(N),YLFT(N),YRT(N)
   52 WRITE(10,56) ILFT(N),IRT(N),YLFT(N),YRT
   56 FORMAT(10X,2I10,2F10.2
   60 CONTINUE
      WRITE(6,100)
  100 FORMAT(1X,42HDO YOU WISH TO ADJUST THE LOCATIONS OF -
     139H CONTOURS?  ENTER 0 FOR NO OR 1 FOR YES)
      READ(5,*) IDR
      IF(IDR.EQ.0) GO TO 500
      WRITE(6,115)
  115 FORMAT(1X,52HAT WHAT TIME INTERVAL WILL THE CONTOURS BE ADJUSTED?)
      READ(5,*) IDTIME
      WRITE(6,107)
```

```
  107 FORMAT(1X,47HENTER I,J VALUE, INCREMENTAL VALUE TO BE ADDED /,
     161H TO THE AVERAGE OF EACH ADJACENT CONTOUR(FT). ENTER IMAX,JMAX /
     124H VALUES,0. WHEN COMPLETE)
  108 READ(5,*) I,J,DREDGE
      IF(I.EQ.IMAX.AND.J.EQ.JMAX) GO TO 499
      WRITE(20,112) I,J,DREDGE
  112 FORMAT(2I5,F10.2)
      GO TO 108
  499 WRITE(20,112) I,J,DREDGE
  500 CONTINUE
      ITIME=1
      WRITE(6,80)
   80 FORMAT(1X,49HENTER WAVE HEIGHT(FT), PERIOD(SECS), ANGLE(DEGS) /,
     162HAND NUMBER OF REPETITIONS OF THAT WAVE FIELD. WHEN COMPLETED.
     1/,19HENTER 99.,99.,99.,0)
   82 CONTINUE
      NREP=0
      READ(5,*) H,T,A,NREPIT
   87 IDD=0
      IF(ITIME.EQ.IDTIME) IDD=1
      WRITE(10,85) ITIME,H,T,A,IDD
   85 FORMAT(1X,I4,5X,3F8.1,I5)
      ITIME=ITIME+1
      NREP=NREP+1
      IF(H.GT.50.) GO TO 90
      IF(NREP.LT.NREPIT) GO TO 87
      GO TO 82
   90 CONTINUE
      STOP
      END
```

END
11-87
DTIC